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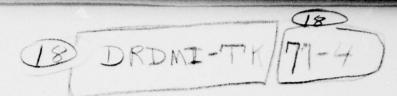
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### **USER'S MANUAL FOR FLAP3**

Robert M. Hackett
Professor of Civil Engineering and Engineering Science
Vanderbilt University
Nashville, Tennessee 37235

DA Project 1A323732D697 AMCMS Code 52337326970012

Propulsion Directorate
Technology Laboratory
US Army Missile Research and Development Command
Redstone Arsenal, Alabama 35809

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### **ACKNOWLEDGMENTS**

The FLAP3 computer code is the result of the efforts of a number of individuals over the past two years. Radwan Juruf and Carl DeVilbiss, graduate students at Vanderbilt University, contributed substantially to the development of the code. Robert Radke made many helpful and vital suggestions relative to implementation of the code. Al Maykut gave invaluable encouragement and advice along the way. These are gratefully acknowledged for their contributions and support.

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# Section 1 INTRODUCTION

Fluid Analysis Program, 3-Dimensions (FLAP3) is a three-dimensional finite element code developed for the purpose of predicting the combustion instability of solid propellant rocket motors. The complete code consists of four phases:

- a) A pre-processor phase (a three-dimensional finite element mesh generator).
- b) The acousto-modal analysis (calculation of the acoustic frequency, mode shape, and corresponding velocities).
- c) The potential flow analysis (calculation of gas flow velocities).
- d) The determination of mode stability/instability (evaluation of stability integrals).

The second phase of the code provides for the coupling of the acoustic response of the rocket cavity with that of the solid propellant grain for the purpose of obtaining a more accurate value (than would be obtained by considering "acoustically hard" cavity boundaries) of the acoustic frequency, and for calculating the amount of structural damping provided by the propellant grain. The solid propellant can be modeled as a virtually incompressible material having a frequency dependent complex modulus. The frequency dependency of the solid propellant modulus may require, in some cases, the employment of an iterative technique to obtain the coupled frequency and the rate of structural damping.

Because modeling of the solid propellant greatly increases the size of the problem, and therefore the cost of running it, the user has the option of a cavity-solid coupled analysis or of a cavity analysis alone. The principle of dihedral symmetry is fundamental in the development of the code and requires that the user generate a finite element mesh only for the geometry of the smallest repeating cavity-propellant segment, the problem being basically one in cylindrical coordinates.

FLAP3 was developed primarily for the following purposes:

- a) To provide generality and accuracy in the modeling of complex combustion chamber geometries.
- b) To provide a means of predicting the damping of acoustic oscillations by the solid propellant grain.
- c) To provide an integrated program designed solely for the purpose of combustion instability prediction with ease of use.

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The main features of FLAP3 are given in the following list and will be explained later:

- a) It utilizes a specially adapted three-dimensional finite element input data generation (FLESH3 and FLSH3P) package.
- b) It utilizes the principle of dihedral symmetry which enables a consideration of only the smallest repeating geometrical segment.
- c) It couples the response of the gas cavity with that of the solid propellant grain to enable the calculation of the frequency of the coupled system and the acoustic wave damping provided by the propellant grain.
- d) It provides for modeling the propellant grain as a nearly incompressible material (which differs from the usual minimum potential energy formulation).
- e) It utilizes the principle of condensation, in which, in this case, the fluid pressure degrees-of-freedom are designated "master" and the solid propellant displacement and mean pressure parameter degrees-of-freedom are designated "slave." This enables a major reduction in the size of the problem; the number of equations is reduced from the total number of degrees-of-freedom of the coupled system to the number of fluid pressure degrees-of-freedom.
- f) It provides the option of considering the response of the gas cavity alone (which models the cavity boundaries as "acoustically hard"). This option might be utilized in certain cases where a savings in computer costs or storage is a dominant consideration. In this case the previously described condensation routine obviously would not be invoked.
  - g) It calculates the three-dimensional potential flow field.
- h) It evaluates the stability integrals for the calculation of the net driving/damping coefficient for each acoustic mode.

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### Section 2 PRE-PROCESSOR — FINITE ELEMENT MESH GENERATOR

It is necessary to develop a finite element mesh for only one repeating segment (Figure 1) of the total cavity-solid propellant rocket geometry. This is true because of the employment of the principle of dihedral symmetry in FLAP3. Although the three-dimensional element used in FLAP3 for both the cavity region and the solid propellant is a tetrahedron [1], the mesh is that of bricks connected at the corners. Each brick, or quasi-hexahedron, is comprised of five basic tetrahedra (Figure 2). The breakdown of the quasi-hexahedron into tetrahedra is performed internally; therefore, the mesh need be no more complicated than that shown in Figure 3.

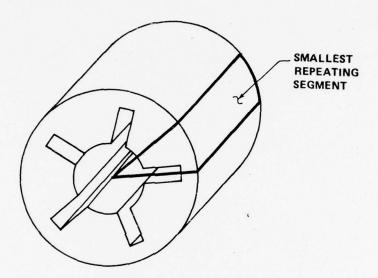


Figure 1. Three-dimensional cavity-solid propellant model.

The pre-processor phase, or finite element mesh generator, FLESH3 (Fluid Mesh Generation, 3-Dimensions), is an efficient routine which automatically creates the complete finite element mesh, consisting of both cavity and solid propellant regions, from a minimal amount of input. Each repeating segment is sectioned in the longitudinal or z-direction, with each section comprised of a number of quadrilateral parts which are identified by a counterclockwise listing of their part boundary curves. Part boundary curves may be ellipses as well as straight lines; their points of intersection are designated by I,J indices as shown in the User's Guide for FLESH3 (Figure 4) which begins on page 14.

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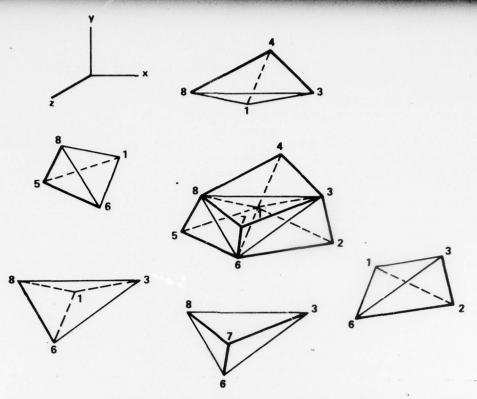


Figure 2. Quasi-hexahedron (brick) composed of five tetrahedra.

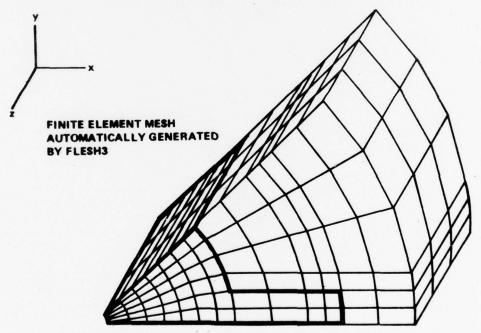


Figure 3. Repeating cavity-solid propellant segment model.

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### Section 3 DISCUSSION

### 3.1 Dihedral Symmetry

If a geometrically defined body is comprised of identical segments symmetrically arranged with respect to an axis, the degrees-of-freedom, for a finite element analysis, can be transformed into uncoupled symmetrical components, thereby greatly reducing the number of equations which must be solved simultaneously [2]. A further reduction occurs if each segment has a plane of reflective symmetry. Dihedral symmetry is the term applied to this latter condition. It can be seen from Figure 1 that a typical solid rocket geometry meets this requirement; therefore, the principle of dihedral symmetry can be employed in a three-dimensional (cylindrical coordinate) analysis. The application of the principle to this problem is explained in detail in Reference 3 and will not be repeated here, but the resulting analysis will be discussed.

Employing the principle of dihedral symmetry, FLAP3 computes three distinct types of acoustic harmonics: the zero harmonic, the K harmonics, and the M/2 harmonic. The zero harmonic exists for all cases and is the only harmonic which does exist for the case of a rocket having an annular cavity. The number of possible K harmonics is given by

$$K = 1, ..., J$$
 (1)

where the harmonic index J is given by

$$J = \frac{M-1}{2} \text{ (if M is an odd number)}$$
 (2a)

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$$J = \frac{M - 2}{2} \text{ (if M is an even number)}$$
 (2b)

where M is the number of radial slots or lobes. For the case of an annular cavity, where radial slots do not exist, an arbitrarily small repeating segment (subtended by a whole number of degrees) may be selected for analysis. The M/2 harmonic exists only when M is an even number. Referring to the geometry of Figure 1, the zero, first, and second harmonics, for example, could be calculated. The latter two are both K harmonics.

The longitudinal modes associated with each harmonic are calculated internally by FLAP3, as requested by the user. The result of this operation (acousto-modal eigensolution) is the natural circular frequency associated with each acoustic mode and the corresponding acoustic pressure distribution (normalized acoustic pressure at each finite element nodal point) for the smallest repeating segment. The pressure distribution in all of the other segments is then simply calculated automatically through the dihedral transformation. The acoustic velocity components (constant for the region occupied by each cavity tetrahedral element) are computed from the acoustic pressure nodal point values for those cavity elements which are adjacent to the solid propellant grain (characterized in FLAP3 as fluid interface tetrahedrons).

The formulation of the complete three-dimensional finite element acousto-modal analysis, in which the natural circular frequency, the acoustic pressure distribution, and the element acoustic velocities are calculated, is given in Reference 4 and will not be repeated here. The theoretical finite element formulation which was used in the development of FLAP3 is also presented in Reference 5.

### 3.2 Coupled Response

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The presence of the solid propellant grain can significantly shift the acoustic system frequency from that of the gas phase alone, a portion of the acoustic energy being dissipated by the deformable solid material. This effect can be one of the more significant sinks for acoustic energy in both large and small rocket motors, the amount of damping depending on the grain geometry and mechanical properties and on the acoustic mode shape and natural frequency.

To evaluate the coupled cavity-solid propellant grain response, it is necessary to model both cavity and grain by the finite element method. This greatly increases the size of the problem to be solved from the standpoint of number of initial degrees-of-freedom. The coupled finite element formulation [5] which is programmed in FLAP3 is expressed in matrix form as:

$$\left(\begin{bmatrix} F & 0 \\ -U^T & K \end{bmatrix} - \lambda^2 \begin{bmatrix} T & U \\ 0 & M & 0 \end{bmatrix}\right) \begin{bmatrix} P \\ \Delta \\ H \end{bmatrix} = 0$$
(3)

where [F] is the fluid inertia matrix, [T] is the fluid compressibility matrix, [K] is the solid stiffness matrix, [M] is the solid consistent mass matrix, [U] is the matrix which couples acoustic pressure degrees-of-freedom to solid displacement degrees-of-freedom,  $\{p\}$  is the acoustic pressure vector,  $\{\Delta\}$  is the solid displacement vector,  $\{H\}$  is the mean pressure parameter vector (to be explained later), and  $\lambda^2$  is the eigenvalue of the coupled system.

The structural damping can be attributed to the out-of-phase response of the solid propellant grain which is measured in terms of the complex shearing modulus of the grain, which, in turn, results in a complex eigenvalue for the coupled system. The imaginary part of the complex eigenvalue obtained from the eigensolution is the natural circular frequency of the coupled system while the real part is the structural damping rate.

Because the complex shearing modulus is frequency dependent, a series of iterations may be necessary before the accurate value of complex modulus for input into the program is determined.

### 3.3 Propellant Grain Modeling

Because the propellant grain is accurately modeled only as a nearly incompressible material, the well-known standard Navier displacement formulation would lead to inaccuracies in the finite element modeling of the grain. To avoid this situation, the solid finite element formulation utilized in FLAP3 is that of a linear displacement-linear mean pressure tetrahedron [6]. It is similar to the Herrmann variational formulation [7] which employs a linear displacement function and a constant mean pressure function. The finite element modeling of the propellant grain used in FLAP3 is outlined in detail in Reference 5 and will not be repeated here.

### 3.4 Eigenvalue Economizer - Condensation

The extraction of eigenvalues and eigenvectors is a far more expensive operation than is the solution of simultaneous linear equations. It requires roughly twice as long to extract a single eigenvalue as it does to do a single static analysis. To reduce or condense the number of degrees-of-freedom in the eigensolution, the following technique is utilized in FLAP3. Further details of the method are found in Reference 8.

The original formulation of the coupled system is given by Equation (3), where the number of degrees-of-freedom is equal to the number of cavity nodal point pressures plus the number of solid propellant nodal point displacement components plus the number of solid propellant nodal point mean pressure parameter values (one at each propellant node) for the analyzed repeating segment. The condensed formulation is given by:

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$$\left(\left[F_{r}\right] - \lambda^{2} \left[T_{r}\right]\right) \left\{p\right\} = 0 \tag{4}$$

where

$$[F_r] = \begin{bmatrix} I \\ K^{-1}U^T \end{bmatrix}^T \begin{bmatrix} F & I & 0 \\ -U^T & K \end{bmatrix} \begin{bmatrix} I \\ K^{-1}U^T \end{bmatrix}$$
(5a)

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$$\begin{bmatrix} \mathbf{T}_{\mathbf{r}} \end{bmatrix} = \begin{bmatrix} \mathbf{I} & \mathbf{I} & \mathbf{U} \\ \mathbf{K}^{-1} \mathbf{U}^{\mathrm{T}} \end{bmatrix}^{\mathrm{T}} \begin{bmatrix} \mathbf{T} & \mathbf{U} \\ \mathbf{0} & \mathbf{M} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{0} \end{bmatrix} \begin{bmatrix} \mathbf{I} \\ \mathbf{K}^{-1} \mathbf{U}^{\mathrm{T}} \end{bmatrix}$$
(5b)

where I is the identity matrix. The relationship between initial and reduced degrees-of-freedom is given by:

### 3.5 Uncoupled Response

Although one of the most important features of FLAP3 is the coupled cavity-solid propellant response analysis capability, the option of a cavity analysis alone is available to the user. In this case, the cavity-solid propellant interface is modeled as an "acoustically hard" boundary. The cavity only option would greatly reduce the computer storage requirements for FLAP3 and would in certain cases, suffice. The user need make only two simple modifications in the input data; these modifications are described in the FLAP3 User's Guide which begins on page 19.

### 3.6 Potential Flow Calculation

The fourth phase of the complete three-dimensional code package utilizes the FLAP3 subroutine which carries out a potential flow analysis for the purpose of determining the mean flow field in the rocket cavity. As in the case of the acousto-modal analysis, only the smallest repeating geometrical segment need be considered; for this calculation, only the cavity portion of the segment with the proper boundary conditions is considered. The same general formulation of the finite element model equations of motion is utilized except that, in this case, the fluid is considered to be incompressible. The mass flow into the cavity from the burning propellant surface is modeled as a cavity-solid propellant interface nodal point quantity.

It is calculated by summing the interface surface areas associated with each nodal point lying on the cavity-solid propellant interface. The solution of the resulting set of linear equations for the mean flow velocity components (constant for each cavity tetrahedron) is explained in Reference 4; it is not considered necessary to go into it in detail here.

### 3.7 Evaluation of Stability Integrals

The final phase of the code consists of the calculation of the stability integrals associated with the various driving/damping coupling mechanisms which occur in the cavity chamber in the presence of combustion and flow. The stability integrals presently incorporated into FLAP3 are those derived [9] for the three-dimensional case, along with the flow-turning formulation. The use of a linear pressure (and therefore constant velocity) tetrahedral element to represent the cavity region enables an exact evaluation of the stability integrals, given the acoustic nodal point pressures and element velocities and the mean flow element velocities from the finite element solutions. At present FLAP3 does not contain a routine for evaluating nozzle damping or particle damping.

The calculation of stability integrals is for the purpose of evaluating the driving/damping coefficient, a, a fact well-known to the combustion community. A positive  $\alpha$  indicates an unstable mode of oscillation while a negative  $\alpha$  indicates a stable mode. The net value of  $\alpha$  computed by FLAP3 is a summation of the computed values of  $\alpha_{\rm pc}$ (pressure coupling),  $\alpha_{\mbox{\scriptsize VC}}$  (velocity coupling),  $\alpha_{\mbox{\scriptsize FT}}$  (flow-turning), and  $\alpha_{SD}$  (structural damping). The value of  $\alpha_{SD}^{}$  is obtained from the complex eigensolution described in an earlier section; the other three  $\alpha$ -values are obtained from the evaluation of the stability integrals. It is known that the pressure coupling mechanism always drives the acoustic oscillations, that the velocity coupling mechanism may either drive or damp the oscillations, and that the flow-turning mechanism always damps the oscillations. The response factors are input into the program as multiples of the stability integrals for the calculation of the  $\alpha$ 's obtained from the different coupling mechanisms. The propellant grain-dependent response functions are obtained from other analyses and utilized as direct input into FLAP3.

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# Section 4 FLESH3 USER'S GUIDE

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Entry

Variable

Columns

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1-51	IMAX	
6-10 <sup>1</sup>	JMAX	
11-15	NNC	Total number of part boundary curves
16-201	IBC	Number of node code sequences
21-30	SCALE	Scale factor to multiply coordinates (Default set to 1)
31-35	NLAY	Number of sections in z-direction
III.	PART BOUNDARY CU	URVE CARDS (2F10.0,2I5,4F10.0) <sup>2</sup>
Columns	Variable	Entry
1-10	A(1,K)	$x$ coordinate ( $x_0$ of ellipse)
11-20	A(2,K)	y coordinate (y of ellipse)
21-25	NN	Number label of curve (for tabulated curves, last card only)
26-30	NP	Blank for tabulated curve Angle subtended by generated ellipse (to nearest degree)
31-40	AA	Radius of ellipse along x-axis
41-50	ВВ	Radius of ellipse along y-axis
51 <b>-60</b> <sup>3</sup>	TH1	Beginning and end angles in degrees,
61-703	TH2	counterclockwise positive from x-axis

IV. NODE CODE SEQUENCE CARDS (515)

Columns	Variable	Entry
1-54	IC	Node sequence type
6-10	11	
11-15	J1	
16-20	I1 (or I2)	
21-25	J2 (or J1)	

V. PART DEFINITION CARDS  $(1415)^5$  (A value of -1 will end this sequence)

Columns	Variable	Entry
1-5	NP	Part number (do not define degenerate parts)
6-10	11	Minimum index of part
11-15	J1	Minimum index of part
16-20	12	Maximum index of part
21-25	J2	Maximum index of part
26-30	L1	Number label of curve from (I1,J1) to (I2,J1)
31-35	L2	Number label of curve from (I2,J1) to (I2,J2)
36-40	L3	Number label of curve from (I2,J2) to (I1,J2)
41-45	L4	Number label of curve from (I1,J2) to (I1,J1)
46-50	MT	Part designator
51-55	NN	Number of additional parts in (I) direction whose constant (I) curves are incremented by 1
56-60	13	Increment in I (I3) default set to 1
61-65	J3	Increment in J (J3) default set to 1
66-70	IR	Set to 1 to invoke Laplace relaxer for this sequence of parts

VI. SECTION LOCATION CARD (F10.0) (The axis origin should be placed at the nozzle end of the cavity)

Columns	Variable	Entry
1-10 <sup>6</sup>	ZO	Distance along x-axis (cavity longitudinal axis)

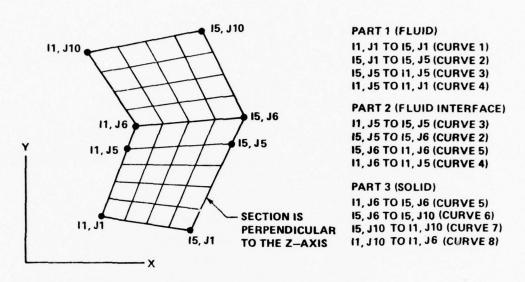


Figure 4. Finite element mesh generation for cavity-solid propellant by FLESH3.

### FLESH3 Notes

- 1. Each node will be identified in a sequence as this input labels the node type. No node may be contained in more than one node sequence.
- 2. Care is necessary in defining part boundary curves to insure that all parts are bound by intersecting curves and that ellipses are cut by other curves passing through them. All part boundary curves, regardless of section location, are labeled and defined in Cards III.
- For tabulated curves, TH1 = 0.; TH2 is blank.

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4. Enter for IC: 1 if fluid node sequence; 2 if interface node sequence; 3 if solid node sequence.

- 5. Each section of a common z-dimension is comprised of four-sided parts which are identified by CCW listing of their part boundary curves; one card for each part (Figure 4). MT is the part designator and identifies all elements within that part as being of the same material. Enter for MT: 1 if fluid part, 2 if interface part, 3 if solid part. Interface parts are those whose elements all have at least one side on the fluid-solid interface. Elements with only one edge on the interface are not interface elements. Enter -1 for NP to terminate each set of part definition cards which define a section perpendicular to the z-axis (cavity longitudinal axis).
- 6. Card VI is placed at the end of a series of Part Definition cards which describe a section. There should be as many Cards VI as there are sections.

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# Section 5 FLSH3P USER'S GUIDE

The use of FLESH3 is limited to continua with consistent part description from section to section. Consequently, when abrupt changes in cross-section configuration occur, it is necessary to run the continua through FLESH3 in segments and to post-process the results to combine the segments. A post-processor, FLSH3P, is provided for such cases. Minimal FLESH3 output manipulation is necessary to enable FLSH3P to renumber all nodes, elements, and interface surfaces, and to redesignate nodes which may fall on the interface surface after consolidation of the segments. FLSH3P will not generate interface surfaces perpendicular to the z-axis (cavity longitudinal axis).

### i. Consolidation control card $(315)^1$

Columns	<u>Variable</u>	Entry
1-52	ND	Number of segments to be consolidated
6-10	IM	Maximum I index of sections
11-15	JM	Maximum J index of sections

# II. SEGMENT CONTROL CARD (515) ("ND" number required)

Columns	Variable	Entry
1-5	NC	Number of nodes in segment
6–10	NF	Number of fluid brick elements in segment
11-15	NS	Number of solid brick elements in segment
16-20	NI	Number of quadrilateral interfaces in segment
21-25	NZ	Number of sections in previous segment (NLAY for previous segment)

### FLSH3P Notes

- The consolidation control card is input as the first record with segment control cards and FLESH3 data following. The segment control cards for each segment precede the segment data cards.
- 2. A value of 0 stops the job.

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### Section 6 FLAP3 USER'S GUIDE

### I. TITLE CARD (80A1)

Columns	Variable	Entry
1-80	ITITLE	Title information Key word "END" stops job
	II. CONT	ROL CARD (315,F10.0)
Columns	Variable	Entry
1-5	NOD	Total number of nodes
6-10 <sup>1</sup>	NTS	Number of interface surfaces
11-152	NSLOT	Number of radial slots
16-25	ANGLE	Angle (in degrees) subtended by smallest repeating segment; must be whole number of degrees if NSLOT = 0
	III. FLUID PR	OPERTIES CARD (15,2F10.0)
Columns	Variable	Entry
1-53	NFB	Number of fluid bricks
6~15	BULK	Fluid bulk modulus
16-25	FDEN	Fluid mass density
	IV. SOLID PRO	PERTIES CARD (15,4F10.0)
Columns	Variable	Entry
1-54	NSB	Number of solid bricks
6-15	SDEN	Solid mass density
16-25	PRT	Poisson's ratio
26-35	GR	Storage modulus
36-45	GI	Loss modulus

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### V. MODAL ANALYSIS CARD - ZERO HARMONIC (315)

Columns	Variable	Entry
1-5 <sup>5</sup>	ZHAR	Enter 1 if zero harmonic is desired; enter 0 if not
6-10	IZM	Enter number of lowest zero harmonic mode desired
11-15	LZM	Enter number of highest zero harmonic mode desired

### VI. MODAL ANALYSIS CARD - M/2 HARMONIC (315)

Columns	Variable	Entry
1-5 <sup>5</sup>	MHAR	<pre>Enter 1 if M/2 harmonic is desired; enter 0 if not</pre>
6-10	IMM	Enter number of lowest M/2 harmonic mode desired
11-15	LMM	Enter number of highest M/2 harmonic mode desired

### VII. MODAL ANALYSIS CARD - K HARMONICS (315)

Columns	<u>Variable</u>	Entry
1-5 <sup>5</sup>	KHAR	Enter number of K harmonics desired; enter 0 if no K harmonics are desired
6-10	IKM	Enter number of lowest K harmonic mode desired
11-15	LKM	Enter number of highest K harmonic mode desired

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# VIII. K HARMONICS CARD (815) (Omit this card if NSLOT = 0 or if KHAR = 0)

Columns	<u>Variable</u>	Entry
1-5	KHD	<pre>Enter 1 if K = 1 is desired; enter 0 if not</pre>
6-10		<pre>Enter 2 if K = 2 is desired; enter 0 if not</pre>
		(continue through all possible
		K harmonics) <sup>5</sup>
36-40		
	IX. COMBUSTIC	ON PARAMETERS CARD (2F10.0)
Columns	Variable	Entry
1-10	GSPEED	Speed of gas leaving the burning surface
11-20	CCM	Mass fraction of particulate material
	X. RESPO	NSE FACTOR CARD (4F10.0)
Columns	Variable	Entry
1-10	RPC	Pressure coupling response factor
11-20	RVC	Velocity coupling response factor
21-30	RFT	Flow turning response factor
31-40	RSD	Structural damping response factor

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XI. NODAL POINT DATA CARDS (15,3F10.0,15)6

(The axis origin should be placed at the nozzle end of the cavity )

Columns	Variable	Entry							
1-5	NNUM	Nodal point number							
6-15	Х	x coordinate							
16-25	Y	y coordinate							
26-35	Z	z coordinate							
36-40 <sup>7</sup>	NTYPE	Nodal point identifier							
	XII. FLUII	ELEMENT CARDS (1015) <sup>8</sup>							
Columns	Variable	Entry							
1-5	ENUM	Brick element number							
6-10 11-15 16-20 21-25 26-30 31-35 36-40 41-45	Global node point numbers corresponding to element nodes	1 2 3 4 5 6 7 8							
46-50		Enter 2 for an element on the fluid- solid interface; enter 1 otherwise							

### SOLID ELEMENT CARDS $(1015)^8$ (Omit these cards if NSB = 0)

Columns	Variable	Entry
1-5	ENUM	Brick element number
6-10 11-15 16-20 21-25 26-30 31-35 36-40 41-45	Global node point numbers corresponding to element nodes	1 2 3 4 5 6 7 8
46-50		Enter 3 22

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### XIII. QUADRILATERAL INTERFACE SURFACE CARDS (615)

Columns	Variable	Entry						
1-5	SNUM	Quadrilateral surface number						
$ \begin{array}{c} 6-10 \\ 11-15 \\ 16-20 \\ 21-25 \end{array} $	Global node point numbers corresponding to element nodes	$\left\{\begin{array}{l}1\\2\\3\\4\end{array}\right.$						
26-30 <sup>10</sup>		Enter 1 for a surface whose outward normal is positive; enter 2 for a surface whose outward normal is negative						

### FLAP3 Notes

- An interface surface is the quadrilateral face of a brick (quasi-hexahedral) which lies on the cavity-solid propellant boundary.
- 2. The program is not limited to the analysis of cavities having narrow radial slots. It is applicable to any similar type geometry such as a star or cloverleaf pattern, or to an annular cavity where NSLOT = 0.
- This is the number of bricks (quasi-hexahedral) making up the cavity portion of a repeating segment.
- 4. This is the number of bricks (quasi-hexahedral) making up the solid propellant portion of a repeating segment. When the "cavity only" option is exercised, NSB is input as 0.
- 5. There are three distinct types of harmonics: zero, K, and M/2. The zero harmonic always exists; the K harmonics are given by

$$K = 1, ..., J$$

where

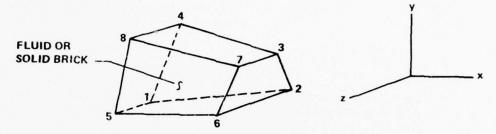
$$J = \frac{M-1}{2} \text{ (for odd M)}$$

$$J = \frac{M-2}{2} \text{ (for even M)}$$

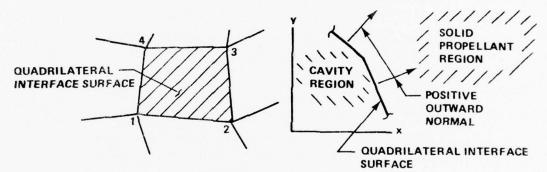
where M is the number of radial slots or lobes; the M/2 harmonic exists only when M is an even number. When NSLOT = 0, only the zero harmonic exists.

- All of the remaining data (Cards XI through XIII) can be automatically generated by the program FLESH3 which is specially developed for use with FLAP3.
- 7. Each nodal point lying inside the cavity region is identified by 1; each nodal point lying on the cavity-solid propellant interface is identified by 2; each nodal point lying in the solid propellant region is identified by 3.
- 8. Element node numbers:

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9. When the outward normal to a quadrilateral interface surface is positive, the surface is designated 1; when the outward normal is negative, the surface is designated 2.



10. If FLESH3 is used to generate the finite element mesh data for FLAP3, all quadrilateral interface surfaces will be automatically designated as 1 (positive outward normal). In cases where the outward normal is actually negative, the designation change to 2 must be made manually.

## Section 7 CONCLUSIONS

Simply stated, FLAP3 performs a linear acousto-modal analysis of the irrotational motions of an inviscid, compressible fluid coupled to the irrotational motions of a nearly incompressible, linearly isotropic viscoelastic solid and a linear potential flow analysis of the irrotational motions of an inviscid, incompressible fluid, and then determines the effect of the flow field and combustion on the calculated acoustic oscillations. There are obvious limitations attached to any code which is as basic as the previously listed restrictions dictate, but it is felt that the developed code presented here is probably as sophisticated as the present state-of-the-art warrants. It is viewed by the developer as having much potential as both a design and a research tool. As the state-of-the-art in combustion technology advances, it is felt that the code can be revised relatively easily and updated to include the new technology; at least it was designed with that in mind.

One of the most attractive features of FLAP3 is the ease of use, which, hopefully, is demonstrated in the examples found in the appendices. Other extremely important attributes are the fact that it is three-dimensional, that it performs a coupled cavity-solid propellant analysis (or, alternatively, a cavity only analysis) and that all analyses are contained in a single program. Features of the code which do not enhance its reputation also exist; they too should be pointed out. It is a large program requiring a large amount of storage and it may require long run times, as is the case with any three-dimensional finite element program. Presently, the entire program is in-core computation, but this will probably be modified. In certain instances, a two-dimensional (axisymmetric) uncoupled analysis provides sufficient accuracy; for such cases, use of the three-dimensional code might not have merit.

It is felt that the demonstrated attributes of FLAP3 far outweigh any foreseen disadvantages and that it can provide the means of performing important analyses which were impossible before its implementation.

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### Appendix A. DIMENSIONS OF VARIABLES

#### MAIN PROGRAM - FLAP3

- The following variables have the fixed dimensions indicated: K(16,16), SUM(16,16), TR(16,16), FF(10,10), SB(10,16), ART(12), N(16), NHARM(16), ITITLE(80).
- The following variables have dimensions at least equal to NOD, where NOD is the total number of nodes whose coordinates are input: X, Y, Z, NP, NR, NT, NZ, NH, SP, NTYPE, SS, ANR, ANT, ANZ.
- 3) The following variables have dimensions at least equal to NIS where NIS is the number of quadrilateral interface surfaces: INS, JNS, LNS, MNS, ISCODE, SAREA, XCON, YCON, ZCON.
- 4) The following variables have dimensions at least equal to 2\*NIS: IST, JST, KST, IDT, IDS, SVX, SVY, SVZ, STAR.
- 5) The variables INT, JNT, LNT, and MNT have dimensions at least equal to 5\*NE, where NE = NFB + NSB, where NFB is the number of fluid bricks and NSB is the number of solid bricks.
- 6) The variables PR and PL have dimensions at least equal to (S,P) where S is one-half of the number of repeating segments and P is the number of fluid nodal points plus the number of interface nodal points.
- 7) The variables MASS, STIFF, and STM have dimensions at least equal to (NUDF, NUDF) where NUDF = (Number of Fluid Nodal Points) + 5\*(Number of Interface Nodal Points) + 4\*(Number of Solid Nodal Points), or NUDF = P, when NSB = 0.
- 8) The variable T has dimensions of (2\*NPD,NPD) where NPD = NUDF P. If NSB = 0, the dimensions of T can be (2\*P,P). If NSB = 0 and KHAR = 0, the dimensions of T can be (1,1).
- 9) The variable KHD has the dimension of KHAR. The variables AL, BW and EIG have the dimension of LZM, LMM or LKM, whichever is larger.

#### SUBROUTINES - FLAP3

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Table A denotes the correspondence between subroutine variables and variables in the main program. All subroutine variables must have the same dimensions as the corresponding variables of the main program.

TABLE A. CORRESPONDENCE OF VARIABLES - FLAP3

Subroutine Variables	Main Program Variables
Subroutine MULTGF BUM	MASS or STIFF
Subroutine MULTGS BUM	MASS or STIFF
Subroutine MULT DUM	MASS or STIFF
Subroutine DETERM S	STM
Subroutine EQSOLV S	STM

#### FLSH3P

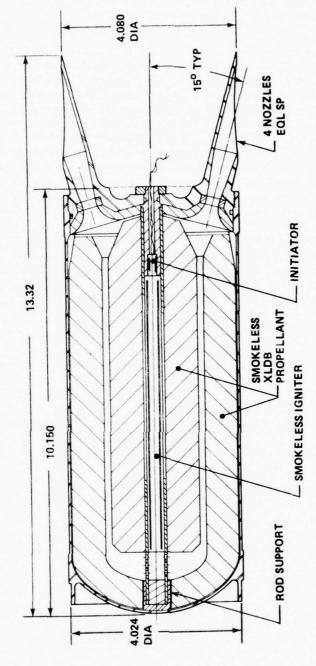
- The variables NP and NM have dimensions at least equal to ISNC where ISNC is the sum of the nodal points in all of the segments which are being combined.
- 2) The variable C has dimensions at least equal to (3, ISNC).
- 3) The variable MF has dimensions at least equal to (10,ISNF) where ISNF is the total number of fluid bricks.
- 4) The variable MS has dimensions at least equal to (10,ISNS) where ISNS is the total number of solid bricks.
- 5) The variable MI has dimensions at least equal to (6,ISNI) where ISNI is the total number of quadrilateral interface surfaces.

# Appendix B. EXAMPLE ANALYSIS OF A TYPICAL BEAM RIDER MOTOR CONFIGURATION

The beam rider motor configuration shown in Figure B has an annular cavity containing a solid propellant core, with solid propellant also at the head end. Because the cavity-propellant geometry undergoes abrupt changes from end to end, the finite element input data to FLAP3 were generated using both FLESH3 and FLSH3P. Because FLESH3 does not automatically generate cavity-propellant interface surfaces which are perpendicular to the longitudinal axis, these surfaces and those interface surfaces having negative outward normals were manually added to those interface surfaces which were automatically generated. It was also necessary to change the designation of some of the nodal points and bricks generated by FLSH3P, for this configuration for the preceding reasons. The changes are systematic and easily made and are noted in the Input to FLAP3.

Because the cavity is annular (no radial slots), the angle subtended by the smallest repeating segment was arbitrarily taken as  $9^{\circ}$ . The fact that only the zero harmonic exists for the case of an annular cavity was recognized, as reflected in the input data. The pages following Figure B contain reduced computer output for the beam rider analysis.

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# Output from FLESH3

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FLESH3 - BEAM RIDER (I)

CARD II. CONTROL.

IMAX JMAX NNC IBC SCALE NLAY 8 2 5 6 1. 4

CARD III. PART BOUNDARY SURVE.

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CARD VI. SECTION LOCATION.

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2	.51000	0.00000	0.00000	3
3	.77000	0.00000	0.00000	3
4	1.03000	0.00000	0.00000	3
5	1.18000	0.00000	0.66000	2
6	1.44000	0.00006	0.00000	3
7	1.70000	0.00000	0.00000	3
8	1. 360 00	0.00000	0.00000	3
9	. 24692	. 13911	0.00000	3
10	.59372	.17978	0.00000	3
11	. 76052	.12045	0.00003	3
12	1.01732	.16113	0.00000	3
13	1.16547	.18459	0.00003	2
14	1.42227	.22527	C.00000	3
15	1.57907	.26594	0.00000	3
16	1.93587	.30661	0.00000	3

NP	[1	J1	12	12	L1	L2	L 3	L4	MT	NN	13	13	IR
1	1	1	4	2	1	+	2	3	3	ű	0		- 5
2	4	1	5	2	1	5	- 2	4	2	6	0	ð	- )
	5												
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CARD VI. SECTION . DCATION.

and a second described on the second of the second second

Z - C0030

N	x	Y	Z	MT
17	. 250 00	0.30006	2.33000	3
18	. 51000	0.00000	2. 33000	3
19	.7700u	0.36006	2.33000	3
20	1.03006	0.30006	2.3300u	3
21	1.18000	0.00000	2.33000	2
22	1. +4000	0.30000	2.33000	3
23	1.70080	0.30000	2.33.00	3
24	1.96000	0.00006	2.33600	3
25	. 24692	. 13911	2. 33000	3
26 .	. 50372	.37978	2.33000	3
27	.76052	.12045	2.33000	3
28	1.01732	.16113	2. 33606	3
29	1.16547	.18459	2.33000	2
30	1.42227	.22527	2.33000	3
31	1.57907	.26594	2.33000	3
32	1,93587	. 30661	2. 33000	3

NP	[1	Jì	12					L4			13		I
1	1	1	4	2	1		2	3	3	0	0	u	-0
2	4	1	5	2	1	5	2	4	2	θ	0	9	- 4
3	5	1						5					
-1	Ű	9						0					

CARD VI. SECTION \_OCATION.

and a second second second second second second second

Z - 00020

N	X	Y	Z	MT
33	. 250 00	0.30000	4.67000	3
34	. 51000	300001.0	4.67000	3
35	.77000	0.30000	4.6700J	3
36	1.63000	0.30006	4. 67800	3
37	1.18003	0.36663	4.67303	2 '
38	1.44000	0.30006	4.67000	3
39	1.70000	0.33006	4.67000	3
40	1.96000	0.10000	4.67000	3
41	. 24692	. 13911	4.67000	3
42	.50372	.17978	4.67000	3
43	. 76052	.12045	4.67003	3
44	1.01732	.15113	4.67000	3
45	1.16547	.18459	4.67000	2
46	1,42227	. 22527	4.67000	3
47	1.57907	.26594	4.67300	3
48	1.93587	.30661	4.67000	3

NP	I1	J1	12	J2	L1	L 2	_ 3	L4	HT		13		
1	1	1	4	2	1		2	3	3				
							2						
							2						
-1	0	0	0	0	0	0	0	0	0	0	0	3	- 3

CARD VI. SECTION . OCATION.

- - ten estadish mise take me hali sangen me

Z - 00010

N		×		Y		Z	HT		
+9	. 2	5000	0.3	0000	7.6	0003	3		
50	. 5	1000	0.0	0000	7.0	0000	3		
51	. 7	7000	0.)	0000	7.0	0000	3		
52	1.0	3000	0.0	0006	7.0	0003	3		
53	1.1	6000	0.3	0000	7.0	0000	2		
54	1.4	+000	0.0	0000	7.0	0000	3		
5.5		0000		0000		0000	3		
56		600G		000 u		0000	3		
57		+692	• 2	3911		0000	3		
58		372		978		0000	3		
59		5052		2045		0000	3		
60		1732		5113		0000	3		
61		5547		8459		0.00	3		
62		2227	• 2	2527		6600	3		
63		7907		5594		0000	3		
64		3587		0661		0000	3		
1	4	5	13	12	SO	21	29	23	2
2	20	21	29	28	30	37	45	4+	2
3	35	37	45	44	52	53	61	50	2
4	1	2	10	9	17	18	26	25	2 2 3 3
5	2	3	11	10	18	19	27	2 ó	3
6	3 5	4	12	11	19	29	28	27	3
7	5	6	14	13	21	22	30	29	3
8	5	7	15	14	55	23	31	30	3
9	7	8	16	15	23	24	32	31	3
10	17	18	26	25	33	3+	42	+1	3
11	18	19	27	26	34	35	43	42	3 3
12	19	28	28	27	35	36	44	43	. 3
13	21	22	30	29	37	38	46	45	3
14	22	23	31	30	38	39	47	+5	3 3 3 3
15	23	24	32	31	39	40	48	47	5
16	33	34	42	41	49	50	58	57	3
17	34	35	43	42	50	51	53	5 8	3
18	35	36	44	43	51	52	60	59	
19	37	38	46	45	53	5+	62	51	3
20	38	39	47	46	54	55	63	62	3
21	39	40	48	47	55	56	64	ó3	3
2	5	13	29	21	1				
2	21	29	45	37	1				
.5	37	45	61	53	1				

CARD I. TITLE.

FLESHS - BEAM RIDER (II)

CARD II. CONTROL.

HAX JMIX NNO IBC SCALE NLAY
8 2 6 6 1. 2

CARD III. PART BOUNDARY CURVE.

X - COORD Y - COORD NP A K-AXIS B Y-AXIS THETAT THETAF NN 0.000 0.00000 0.0000 0.010 0 0 0.00000 0.0000 0.000 2.013 1 0 0.00380 0.03300 0.00000 0.00000 0.00000 0 0.00000 0.00000 6.0000 1.975 .313 2 0 0.00000 0.03630 0.00000 ....... .25000 1.03))) 0.010 .25000 1.03000 0.000 3 0.00000 9.00000 0.030 0.000 4 9 G. 0G0G0 9.00003 5 9 1.10000 0.010 0.000 1.18000 0.00000 9.00000 1.95000 0.010 0.600 6.00000 9.00000

CARD IV. NODE JODE SEQUENCE.

I - server better the experience on the bound of the

IC [1 11 12 JZ 1 3 2 1 1 2 3 1 1 2 1 1 4 2 5 1 5 3 ó 1 8 1

Marie Marie

NP	[1	J1	15	JZ	L1	LZ	_ 3	L4	HT	NN	13	J3	15
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2	4	1	5	2	1	5	2	4	2	Ü	0	U	- 1
3	5	1	8	2	1	ó	2	5	3	0	0	2	- 3
		0											

CARD VI. SECTION . OCATION.

- - man latter in me many the later we have a compression in some

Z - COORD

		41		
N	X	Y	2	HT
. 1	. 25000	0.30000	7.00000	1
2	.51000	0.00000	7.00000	1
3	.77000	0.30000	7.00000	1
4	1.03000	0.00006	7.00000	1
5	1. 180 00	0.30000	7.00000	2
6	1.44000	0.00000	7.60000	3
7	1.70000	0.30000	7.00000	3
8	1.96000	0.36066	7.60000	3
9	. 24692	.33911	7.00000	1
10	.50372	.37976	7.00000	1
11	.76052	.12045	7.00000	1
12	1.01732	.16113	7.00000	1
13	1.16547	.18459	7.00000	2
14	1.42227	.22527	7.60000	3
15	1.57907	.26594	7.00000	3
16	1.93587	.36661	7.60000	3

NP	[ 1	J1	12	JZ						NN			15
1	1	1	4	2	1		2	3	1	G	0	3	-3
2	4	1	5	2	1	5	2	4	2	0	0	0	- 3
3	5	1	8	2	1	6	2	5	3	0	0	0	- 0
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CARD VI. SECTION LOCATION.

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Z - 60030

	N	x		Y		Z	МТ		
17	. 25	000	0.10	3000	7.50	3000	1		
18	.51	000	0.00	0000	7.50	0003	1		
19	.77	000	6.30	000	7.50	0000	1		
20	1.03	0000	0.00	000	7.56	0000	1		
21	1. 18	0000	0.10	3000	7.50	0000	2		
22	1.44	000	0.00	000	7.50	0000	3		
23	1.70	1000	0000	0000	7.56	0000	3		
24		0000	0.00	0000	7.50	0000	3		
25		692		911	7.50	0000	1		
26		372	.17	978	7.50	2000	1		
27	. 76	052	.12	2045	7.50	0000	1		
28			. 16	113	7.50	000	1		
29	1.16	547	.18	3459	7.50	0003	2		
30	1.42		.22	2527	7.50	0000	3		
31	1.57	907	. 26	594	7.50	1003	3		
32	1.93	5 8 7	. 30	1661	7.50	0000	3		
1	1	2	10	9	27	18	26	25	1
2	2	3	11	10	13	19	27	25	1
3	3	4	12	11	19	20	28	27	1
4	4	5	13	12	20	21	29	25	2
5	5	6	14	13	21	22	30	29	3
6		7	15	14	22	23	31	30	3
7		8	16	15	23	24	32	31	3
1	7 5	13	29	21	1				

CARD I. TITLE.

FLESH3 - BEAM RIDER (III)

CARD II. CONTROL.

IMAX JMAX NNC IBC SCALE NLAY

CARD III, PART BOUNDARY SURVE.

X	-	C005D A	-	COURD	NN	NP.	A X-AXIS	B Y-4xIS	THETAI	THETAF
		0.016		0.000	0	0	0.06039	0.00000	6.00000	6.00000
		2.010		0.000	1	0	0.00000	0.03635	0.01000	
		6.033		0.000	0	6	0.00000	6.33000	0.06000	0.60003
		1.975		.313	2	0	0.00000	0.03000	0.00000	0.00000
		0.010		0.000	3	9	. 25830	.25000	0.00000	9.00000
		0.030		0.600	4	9	1.03000	1.03000	6.00000	9.0000.
		0.030		304.5	5	9	1.18333	1.13000	0.00000	9.00000
		0.010		0.000	6	9	1.95000	1.95300	0.00000	9.10001

CARD IV. NODE CODE SEQUENCE.

and a second parent white enjoy to him the said to describe the contract of

IC	[1	JI	12	J2
3	1	1	3	1
3	1	2	3	2
3	4	1	4	2
3	5	1	5	2
3	ó	1	8	1
3	6	2	8	2

NP	11	JI	12	12				L4				13	15
1	1	1	4	2	1		2	3	3	a	0		-1
2	4	1	5	2	1	5	2	3 4	3	0	0	2	- 2
3	5	1	8	2	1	5	2	5	3	0	0	6	- 1
-1	п	0	•	Ω	0	1	1	0	a		n	-	-1

CARD VI. SECTION \_OCATION.

or a record form after appropriately marked and account to the con-

Z - COORD

N	x	Y	Z	HT
1	. 25000	0.30000	7.5000:	3
2	. 51000	0.30000	7.50000	3
3	.77000	0.36000	7.50000	3
4	1.03000	0.30000	7.50000	3
5	1. 18000	0.30000	7.50000	3
.6	1.44000	0.30000	7.50000	3
7	1.70006	0.30060	7.50003	3
8	1. 96000	0.30000	7.50000	3
9	. 24692	.33911	7.50000	3
10	. 50372	.17978	7.50000	3
11	.76052	.12645	7.50000	3
12	1.01732	.16113	7.50000	3
13	1.16547	.18459	7.50003	3
14	1.42227	.22527	7.50000	3
15	1.67907	.26594	7.50000	3
16	1.93587	.30661	7.50000	3

NP	I 1	Jı	15	J2	LI	F 3	_ 3	L4	HT	NN	13	13	15
1	1	1	4	2	1	•	2	3	3	C	0	3	- 0
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3	5	1	8	2	1	ó	2	5	3	0	0		-0
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CARD VI. SECTION LOCATION.

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Z - COORD

N		X	Y		Z	MT		
17	. 25000	0.00	000	8. 20	000	3		
18	.51000	0.30	000	8.20	1000	3		
19	.77000	0.30	3000	8.20	1003	3		
20	1.03000	0.30	0000	8.20	0000	3		
21	1.18000	0.36	0000	8. 20	1000	3		
22	1.44000	0.00	000	8.20	0000	3		
23	1.70000	0.30	000	8. 20	1603	3		
24	1.96000	0.30	000	8.20	000	3		
25	. 24692	. 33	911	8. 20	000	3		
26	. 50372	. 37	978	8.20	0000	3		
27	.76052	. 12	2045	8. 20	1004	3		
28	1. 01732	. 16	113	8. 20	1000	3		
29	1.16547		3459	8.20	0000	.3		
30	1.42227	. 22	2527	8. 20	2000	3		
31	1.57907	. 26	594	8. 20	0000	3		
32	1.93587	. 31	1661	8 . 20	600	3		
1	1 2		9	17	13	26	25	3
2	2 3	11	10	16	19	27	25	3
3	3 4		11	19	21	28	27	3
4	4 5		12	20	21	29	28	3
5	3 6		1.3	21	55.	30	23	3 3 3 3
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?	. 1000	9.00000	0.00000	3
3	.77000	0.00000	0.00000	3
4	1.93000	0.00000	0.00000	
•	1.18000	0.00000	0.00000	,
6	1.44000	0.00000	C.00000	*
7	1.70000	0.00000	0.00000	3
8	1.96000	0.00000	0.00000	
9	.24692	.03911	0.00000	3
17	.50372	. 17979	0.00000	3
11	.76852	.12045	0.00000	3
12	1.01732	.16113	0.00000	3
13	1.16547	.18459	0.00000	2
14	1.42227	.22527	0.00090	3
15	1.57907	. 25 E CL	9.00000	7
16	1.93587	.30661	0.00000	3
17	.25000	6.000 (*	2.330 90	3
1.8	.51000	0.000.00	2.33000	3
19	.77000	0.60060	2.330	*
20 21	1.03000	0.00000	2.33080	3
22	1.44000	0.00000	2.33000	•
23	1.70000	0.08090	2.33000	3
24	1.96000	0.00000	2.33890	7
25	.24692	. 03911	2.33949	3
26	. 50372	.07978	2.33000	*
27	.76052	.12045	2.33000	3
25	1.01732	. 16113	2.337 00	7
29	1.16547	.18450	2.37890	2
30	1.42227	.22527	2.33000	3
31	1.67907	. 26 594	2.33000	3
32	1.93587	. 306 11	2.33090	7
33	.25000	0.00000	4.67690	*
34	.51000	0.00000	4.67000	3
35	.77000	0. 60 0 00	4.67000	
36	1.03000	6. 60000	4.67000	*
37	1.18000	6. 18 18 8	4.67090	2
38	1.44000	0.00000	4.67000	3
39	1.70000	0.00000	4.67000	7
40	1.96000	0.00000	4.67800	,
41	.24692	.03911	4.679 00	7
43	.76052	.12845	4.67000	3
44	1.01732	. 15 11 3	4.67000	3
45	1.16547	.184 50	4.67600	
46	1.42727	.22527	4.679 0	5
47	1.57907	. 255 14	4.67000	
4.8	1.93587	.306 -1	4.67000	3
49	.25000	0. 00 0 00	7.00000	3
50	.51000	0.08000	7.69000	3
51	.77000	0.0000	7.69000	7
52	1.03000	0.0000	7.00200	3
51	1.18000	0.00000	7.02000	2
54	1.44000	0.08080	7.80000	3
. 50	1.70680	0.0000	7.0000	
56	1.95000	0.0000	7.00000	3
57	.24692	.03911	7.00000	7
58	.50372	.07979	7.00800	3
59	.76052	.12045	7.00000	7
60	1.91732	.16113	7.00000	

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5	5	6	14	13	21	22	3*	29	3
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7	7	R	16	15	23	24	32	71	3
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23	1.70000	2.00000	2.33000	7
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39	1.70000	0.00000	4.67080	3
40	1.96900	0.00000	4.67000	7
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63	1.679		. 26594		0000	3					
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59	.760	52	.12045	7.0	0000	2	-				
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FLAPS - BLAY RIDER

TITLE.

CARD I.

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CARO II.	CARD III.	CARD IV.	CARD V.	GARD VI.

C JARJONIC (KHAR)
INITIAL C HARMONIC HOUE (IKM)
LAST C HARMONIC HOUE (LKY)
NUMBER OF K HARMONICS EXISTING (NKY)

CARD VII.

# CARD IX. COMBUSTION PARAMETERS.

SPEED OF GAS LEAVING THE BURNING SURFACE ( GSPEED ) = 13.30 HASS FRACTION OF PARTICULATE MATERIAL ( 32M ) = 0.00

### CARD X. RESPONSE FACTORS.

or record of the last organization was ball to be well and the

PRESSURE COUPLING ( RPC ) = 1.000
VELOCITY COUPLING ( RVC ) = 1.000
FLOW TURNING ( RFT ) = 1.000
STRUCTURAL DAMPING ( RSO ) = 1.000

### CARD XI. NODES AND THEIR COCRCINATES.

LACON	POINT X - COURDINATE	Y - COORDINATE	Z - COORDINAT	NODE DESCRIPTION
2	.25100	.0.000	0.00003	3
	.51000	0.3000	0.0000	3
3	.77.30	0.50333	0.0000	3
4	1. 03000	0 00 166	0.0000	2
5	1.18300	0.0000	3.00000	2
6	1.4+000	0.00000	0.0000	. 3
7	1.70000	0.00000	0.00000	3
8	1.96000	0.65300	0.00000	3
9	. 24092	. 3911	3.60000	3
10	.50372	. 17978	0.0000ú	3
11	.76352	.12345	0.00000	3
12	1.01732	.15113	0.00000	ź 2
13	1. 16547	18+59	3.00000	
14	1.42227	. 22527	J. 0 C 0 0 0	3
15	1.67907	.25594	0.00000	3
15	1.93387	. 35661	0.00600	3
17	. 250 00	0.00000	2.33000	3
18	.51000	0.06300	2.33000	3
19	.77.00	0.00300	2.33000	3
23	1.03000	0.00300	2.33500	2
21	1.18300	0.00000	2.33000	2
22	1.44000	6 36696	2.33000	3
23	1.70.00	1.22002	2.33	3
24	1.96000	0.60300	2.33664	3
25	.24092	.03911	2.33000	3
20	.50372	. 17978	2.33000	3
27	.76052	12045	2.33640	3
28	1. 117 32	.15113	2.33000	2
29	1.16,47	.18459	2.33606	2
30	1.42227	.22.27	2.33000	3

31	1.67307	26594	2.33.00	3
32	1.93567	.33561	2.33000	3
33	. 25000	0.00000	4.67600	3
34	.51000	0.00000	4.57000	3
35	.77000	0.06303	4.57606	3
36	1.43300	6.00306	4.67464	2
37	1.18000	0.00	4.67010	2
38	1.44.00	.6.00003	4.67000	3
39	1.70000	0.00000	4.67000	3
40	1.96000	0.00000	4.67000	3
41	. 24092	3911	4.67300	3
42	.50372	. 27978	4.67000	3
43	.76352	.12045	4.07000	3
44	1. 41732	.1:113	4.67000	2
45	1. 16547	13459	4.67000	2
40	1.42227	. 22527	4.67606	3
47	1.67907	. 25594	4.67000	3
43	1.93587	. 30 661	4.67000	3
49	. 250 00	0 00000	7.003.0	2
50	.51000	0.06.36	7.000.0	2
51	.77000	0.00000	7.00000	2
52	1.03000	3.00000	7.00000	2
• 53	1.18300	0.00000	7.00000	2
54	1.44300	0,00000	7.36.60	3
5-	1.70000	3.01010	7.00000	3
56	1.96.00	0.33333	7.30.30	3333333332233332222333322223333222233332222
57	. 24692	.03911	7.00000	2
58	. 50372	17978	7.06380	2
59	.76752	.12345	7.00000	2
60	1.61732	.15113	7.60.60	2
61	1.16547	.18459	7.00636	2
62	1.42227	-22227	7.00.00	3
63	1.67907	. 25594	7.00.00	3
ō+	1.93587	.3.001	7.00000	3
65	. 25000	0.00010	7.50000	2
65	.51000	0.0000	7.50000	2
67	.77000	0.00110	7.50603	2
68	1.03000	0.30003	7.58000	2
69	1.18000	0.00000	7.50000	21
7.	1.44000	0.00000	7.50000	3
71	1.70000	0.00000	7.50000	I
72	1.96000	9 00000	7.50000	3
73	. 24692	.03911	7.50000	3 2 2 2 2 2 3 3
74	.50372	.37975	7.50000	2
75	.76352	.12045	7.50000	2
76	1.01732	.15113	7.50430	2
77	1. 16547	.18459	7.30000	2
78	1.42227	. 22527	7.50000	. 3
79	1.67907	. 25594	7.50.50	3

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•	ю	m		2 1	m	m	8	<b>m</b>	•	m		<b>m</b>	•	~	m	~	m
7.50000	8,20000	8.20006	0.000	900000	8.20000	8.20030	8.20000	8.20000	8.20000	9.20000	9. 20660	8.20000	8.26000	8.20000	9.20000	8.20553	8.20000
. 30061	000000			000000	0.00000	0.0000	0.00000	0.00330	9.00.00	.03911	. 37978	.12,45	.15113	.13+53	. 22527	. 20594	.33651
1. 93587	. 25:00	00:+0		2022	1.03000	1,18300	1.44.00	1.70000	1.96.00	. 24092	,50372	.75.52	1.01732	1.16547	1.42227	1.67.937	1.93587
90			30	63	10	<b>40</b>	99	87	98	58	96	91	95	93	16	56	96

KELATIONSHIP.
NOLE
•
ELEMENT
xiI.
CARD

NOOES		3,					
ON NO	20	36	55	69	90	. 67	0.0
	4	28	<b>t</b>	2.5	5.8	53	20
	13	53	10	2.9	5.3	9.6	5.1
	יי	21	37	5.7	51	35	53
	ı	26	36	6,		1.6	5.5
BRICK		2	m	•	10	0	7

# CARD XIII. QUADRILAFERAL INTERFACE SURFACES AND THEIR NOJES AND SURFACE DESCRIPTION.

-	-	-1	-	-	-	-1		2	~	۲.	۸.	2	^1
21	37	53	6.0	73	12	7.5	7.e	92	36	3.5	5.5	50	65
23	•	0.1	11	7.	7.5	7.5	7.7	23	;	0.0	5.5	10	,,0
13	53	63	61	0.0	10	5.5	6,0	12	2.9	;	3.0	5:	25
	21	37	٠,	6.5	60	29	60	,	25	35	6	.,	13
	2	2	,	0	U	1-	0	6	1:	11	12	13	1.1

POTE TIAL FLOW ANALYSIS

	- 98	-99.643	-93.28	-38.35,	-77.482	-77 - +31	-77.33.	-77.+9"	5 . 5 .	-50.35.	-50.+2:	-55.18:	-12.23	-12.31:	-12.29	-12.31:	-12.31:	-13.30+	-12.31:	-13.29.	-13.29.	-15.832	-13.363	-10.+33	-10.43:	-17.143	-15.53:
VELOCITES	1.05.	-1.973	0.31.	0.632	3++	-1.353	.747	-1.73,	-2.23.	-3.9+0	.133	-1.77.9	.83-	354	.737	2.0	113	-1.045	. 630	81,	-1.103	-3.172	FC0	-1.313	-3.52+	-5.073	-3.81.
×	.8	-11.8	05	0.633	-3 813	-111. 93	-12.2.	-8.8	-7.92	2+3 6-	-1123	-8.812		(73	17		73	-1::1-	10.	1.1.5	-2.58	-332	2 982	3.1.1	-8.332	-10.43	126.7-
SURTAGE ARFAS		.2157	.1883	.2157	.1691	. 2165	1881.	.2166	633	.2157	.1833	.2157	. udil	.110+	51	.110+	.113+	.:157	. 110+	. 157	157	203	157	239	121	. 1463	403
INTERFACE	23	13	,	21	1 #	59	50	37	2.0	4	3,	5.3	39	73	5+	or #	5.5	7-7	5,	5.	6.8	. 7.	51	51	63	19	59
NODES ON	25 *	29 21	28 12	5 13	36 20	25 55	+4 28	21 29	52 35	61 53	30 70	37 +5	55 73	7+ 50	57 58	90 28	56 74	15 51	58 59	51 59	57 75	86 58	56	52 53	58	65 22	53 51
SECON SI	2:	13		21	37	23	2.	37	5.3		3:	53	5.5	5.3	f.+	5.5	2.0	.35		2.0	j.c	2.	.4	5.0		10	n n
AND THE	23	23	5 1	,	†	† \$	67	23	70	9	101	30	7.3	73	20	<b>†</b>	7+	7+	5.3	10	7.5	7.	έĵ	1,0	75	70	63
TETRAHESHA I																											
INTEFFACE TE		2 23								0		2	3	,	2	Q		8	5		1	2	3		un	9	2

HARMONIC 0 MODE 0

FREQUENCY 6.LEG RADISEC

u.udu HZ

SEGMENT 1 R

A ---- ---- Carrel Salver appropriate in the South Contract of

NODE NUMBER	ACOUSTIC PRESSU	₹ 5
4	1.06600	
5	1.00000	
12	1.00.03	
13	1.00000	
21	1.00000	
21	1.00660	
28	1.00000	
29	1.00000	
36	1.00000	
37	1.00000	
44	1.06600	
45	1.00000	
49	1.0000	
50	1.00000	
51	1.0000	
52	1.00000	
53	1.00660	
57	1.0000	
58	1.00000	
59	1.00600	
ćū	1.00600	
61	1.00000	
65	1.00000	
66	1.00600	
67	1.00000	
68	1.00000	
69	1.00600	
73	1.0000	
74	1.00000	
75	1.00000	
7 E	1.00000	
77	1.00003	

### SEGMENT 1 L

NODE NUMBER	ACOUSTIC PRESSURE
	1.00000
5	1.00600
12	1.00000
13	1.00600
2,	1.0000
21	1.06600
65	1.03000
29	1.0000
36	1.00000
37	1.06600
44	1.00000
45	1.06605
49	1.00636
50	1.03000
51	1.00000
5.2	1.00600
5 3	1.00000
57	1.0000
58	1.0000
59	1.06000
60	1.03603
61	1.0000
6:	1.0.00
66	1.00600
67	1.0000
68	1.00000
69	1.00000
73	1.06665
74	1.00003
7-	1.0000
7 ĉ	1.00000
7 🖟	1.00000

and the state of t

HARMONIC 0 MODE 1

FREQUENCY 4881.528 RAD/SEC

775.919 HZ

SEGMENT 1 R

we are the second of the secon

NODE NUMBER	ACOUSTIC PRESSUR
	-1.23444
5	-1.23395
12	-1.23408
13	-1.23450
20	-,83563
21	83663
28	83661
29	83559
3 ô	•10 <del>65</del> 3
37	.16516
44	.10 521
45	.10 €63
49	1.01388
50	1.00910
51	.99626
52	.97677
53	.97513
57	1.01383
58	1.00967
5 9	.99843
60	.97699
61	.97565
65	1.02126
66	1.01767
67	1.01664
68	1.00130
69	1.00665
73	1.02140
74	1.01775
75	1.01(21
76	1.00112
77	1.00000

# SEGMENT 1 L

NODE NUMBER	ACOU	STIC	FRESSUR	٤
4		-1.2	3444	
5		-1.2	3395	
12		-1.2	3408	
13		-1.2	3450	
20		8	3563	
21		8	3663	
28		8	3661	
29		8	3559	
36		. 1	650	
37		.11	510	
44		. 10	521	
45		.1	663	
49		1.0:	1 388	
5 .		1.00	910	
51		. 99	626	
52		.9	7677	
53		.97	7513	
57		1.01	1 38 3	
58		1.00	1967	
59		.99	843	
6		.97	7699	
61		.97	7565	
65		1.02	2128	
66		1.01	767	
67		1.01	CG4	
6.8		1.00	130	
69		1.00	1666	
73		1.02	2140	
7+		1.01	.775	
75		1.01	.021	
7 c		1.00	112	
77		1.00	000	
ZERO HARMONIC	MODE	1 .		

ALPHPC = 16.32 ALPHVG = 1.14 ALPHFT = -154.14 ALPHSO = C., 0 ALPHA = -136.17

The second section of the second second second second

FREQUENCY 10984-151 RAU/SEC

1748.182 HZ

SEGMENT 1 R

and the state of the said of t

NODE NUTBER	ACOUSTIC PRESSURE
	2.15202
5	2.15963
12	2.15[26
13	2.16226
20	29932
21	29315
28	29363
29	29976
36	-2.08617
37	-2.08165
44	-2.08152
45	-2.07952
+9	1.07603
5.	1.05628
51	.96222
52	.88187
53	.87181
57	1.07577
58	1.05328
59	.99356
60	. 88180
61	.87678
65	1.11444
66	1.09480
67	1.05353
68	1.00 €93
69	1.0:318
73	1.11507
74	1.09511
75	1.05414
76	1.00 582
	1.01000

# SEGMENT 1 L

	NODE NUMBER	ACOUSTIC	FRESSURE
		2.1	6202
	5	2.1	5 96 3
*	12		6626
	13		6228
	20	2	9932
	21	2	9315
	28	2	9360
	29	2	9976
	30	-2.0	B C17
	37	-2.0	8165
	44	-2.0	3152
	45	-2.0	7 95 2
	49	1.0	
	50	1.0	
	51	.98	3222
	52		3187
	53		181
	57	1.0	
	58	1.0	328
	59	.99	356
	6 ū	.86	185
	61	.6	7678
	63	1.1:	1444
	66	1.09	480
	67	1.0	5353
	68	1,88	€93
	69	1.00	318
	73	1.11	567
	7+	1.09	511
	75	1.09	414
	76	1.00	582
	77	1.00	0.69
	ZERO HARMONIC	MODE 2	
ALPHPC =	16.28		
ALPHVC =	8.27		
ALPHET =	-236.78		
ALPHSO =	0.13		
ALPHA =	-152.23		

FREQUENCY 16209.701 RAD/SEC

2898.164 HZ

SEGMENT 1 R

- many factor with resident one sales inches and the

NODE NUMBER	ACOUSTIC FRESSURE
	-7.00367
5	-6.99784
12	-6.99922
13	-7.00366
2.	6.16173
21	6.15188
28	6.15318
29	6.16218
36	-3.87148
37	-3.85433
44	-3.85601
45	-3.87143
49	1 25332
5	1.17[87
51	.96611
52	.66613
53	.63371
57	1.25243
58	1.18634
59	.99412
6.	.65326
61	•65296
65	1.36570
6è	1.3.141
67	1.16803
63	1.02218
. 69	1.00812
73	1,36764
7-	1.30168
75	1.16786
7 ò	1.01766
77	1.00000

# SEGMENT 1 L

NODE NUMBER	ACOUSTIC PRESSURE
	-7.00367
	-6.99784
5	-6.99922
12	-7.0 u 366
13	6.16170
2û	6.15188
21	6.15318
28	6.16218
29	-3.87148
36	-3.85433
37	-3.85601
44	-3.87143
45	1.25332
49	1.17687
	.96611
51 52	.66613
53	.63371
57	1,25243
58	1.18004
59	.99412
60	.66326
61	.65296
65	1.36570
66	1.30 141
67	1.16603
68	1.02218
69	1.03812
73	1.36764
7.	1.36168
75	1.10788
76 76	1.01766
77	1.00600
ZERO HARMONIC	MOUE 3
= 15.35	
= 34.51	
210 24	

and a second design and a second and a second as the secon

# Appendix C. EXAMPLE ANALYSIS OF A TYPICAL FOUR-SLOT FINOCYL MOTOR CONFIGURATION

A typical four-slot finocyl rocket is shown in Figure C. Because the cavity-propellant geometry undergoes rather abrupt changes from end to end, the finite element input data to FLAP3 were generated using both FLESH3 and FLSH3P. The pages following Figure C contain the reduced computer output sheets for the finocyl analysis.

a result forces of the safety to the last of the same and the same

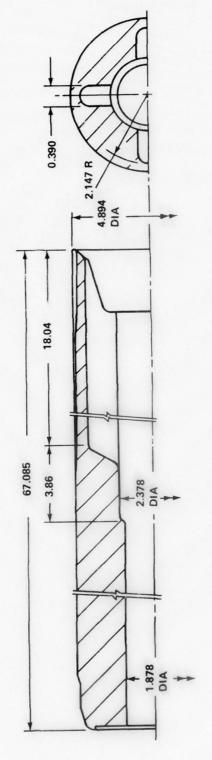


Figure C. Typical four-slot finocyl motor configuration.

-

a price of the state of the sale on the sale of the sale of

	FLES	13 -	F	INOCYL	(I)							
5	3	10	,	1.0 0 1		3						
	0.3		0.)	٤	Ĺ		0.6		2.5		3.0	0.0
	3.0		0.1	1	O		0.0		0.0		0.0	0.0
	0.3		0.1	0 2 3 4 5 7 8	C		0.0		1.3		3.0	0.0
	3.0		3.1	2	L		0.0		2.3		1.3	2.6
	0. 3		6.3	3	90		0.1		0.1		3.3	90.0
	0.0		0.1	4	90	0.	939	3.	939		3.0	90.0
	0.0		0.1	5	9 C	1.	189	1.			0.0	90.0
	0.3		0.3	7	90	2.	147	2			3.9	90.0
	3.1		0.1	8	90		347		3+7		3.0	90.0
	0.0		0.1		96	2.	433	2.	+ 33		0.0	90.0
	0.0		6.1	G	0		0.C		0.5		3.3	0.0
1.1	7285	ű.	195	11	0		3.0		0 • t		0.0	0.0
	0.3	0.	195	C	ũ		0.0		0.3			Ú • U
	3.1		195	12	e		0. C		0.3		0.0	0.0
1	1	1	1	3								
1	2	2	3	3								
1	<	1	,	1						,		
2	5	2	3	3								
2	3 +	3	•	2								
3	+	3	,	3								
1 2 2 3 3 1 2 3 4 5 6 7 8	1	1	3	3 2 3 2 3 2 3 2 3 2 3	1			,				
1	1	1 2 1 2	:	-		4	11	3	1			
2	2 2 3	2	- ;	3	11	4	2 11 2 12	*	1			
3	2	2	3	7	11	5	11	•				
=		1	,	2	1	7	12	5	2 2 3			
5	3	2		3	12	7	12	5	3			
7	+	2	j	2	1	8	12	ŕ	3			
A		2	í	3	12	8	2	r	3			
-1	•	•	•	•		•	•	•	J			
-	0.0											
1	1	1	?	2	1	4	11	3	1			
2	1	2	2	3	11	4	2	3	1			
3	2	1	3	2	1	5	11	4	1			
4	2 3 3	2	-3	3	11	5 7	12	4	2			
5 6 7 8	3	1 2		2	1 12	7	12	5	2 2 3			
6		2	+	3	12	7	12	5				
7	+	1	,	2	1	9	12	7	3			
8	4	2	5	3	12	9	2	7	3			
-1												
	8.13											
2	1	1	2	2	1	4	11	3	1			
2 3	1	2	2	3	11	4	2	3	1			
3	2	1	3	2	1	5	11	4	1			
5	2 2 3	2	3	3	11	7	12	4	2			
5	3	1	*	2 3 2 3	1		12	5	2			
6	3	2	*	3	12	7	2	5	3			
7 8	. 4	1	3	2	1	9	12	7	3 3 3			
	4	2	j	3	12	9	2	7	3			
-1	6.25											
1	0 . 20											

	FLESH	3 -	F	INUCYL	(II)						
ŝ	3	10	;	1.0		2					
	0.0		0.3	0	0		0.0		2.0	0.0	0.0
	3.0		0.1	1	C		0.0		0.0	0.0	u . 0
	0. ú 3. ú		0.1 3.1	C	C		0.0		0.0 1.6	9.3	0.0 0.0 90.6
	3.0		3.1	2 3	C		0.6		1.1	0.0	U. U
	0.0		0.1	3	96		0.1		. 1	0.0	90.0
	0.3		0.1	4	90	G.	939	3.	939	0.0	90.0
	0.3		6.1	5	90	1.	.189	1.	133	0.0	90.0
	0.)		0.1	5 7 9 10 (	91	2.	. 147	2.	1 4 7	3.3	90.0
	0.3		0.3	9	96	2.	. 433	2.	+ 33	0.0	90.0
	0.3		0.)	10	96	2.	.447	2.	1	3.0	90.0
	0.0		0.1	C	0		0.0		0.0	0.0	L. C
1.1	0.0 7285	0.	19;	11	C		3.0			2.6	Jet
	0.3	ů.	195	6	C		3.8		0.8	6.0	G . 0
	3.1	ũ.	195 195 195	12	C		0.0		:	0.0	0. L 0. 0 0. 0
1	1 2 3	1	2 3	3							
1	2	1 .	2	3							
5		1 .		3							
3	+	1		3							
1 1 2 3 3 1 2 3 4 5 6 7 8 - 1	1 1 2 2 3 3	1 1 2 1 2 1 2 1 2	3	0 12 3 3 3 3 3 3 2 3 2 3 2 3 2 3 2 3 2 3							
1	1	1	2	2	1	4	11	3	1		
2	1	2	5	3	11	4	2	3	1 2 2 3 3 3 3 3		
3	2	1	3	2	1 11	5	11	4	2		
4	2	2	3	3	11	5 5 7	2	4	2		
5	3	1	+	2	1	7	12	5	3		
6		2		3	12	7	12	5	3		
7	+	1	;	2	1 12 1	9	12	5 7 7	3		
8	+	2	,	3	12	9	2	7	3		
-1											
	6.26										
1	1	1	2	2	1	4	11	3	1		
3	1	2	?	3	11	4	2	3	1		
3	1 2 2 3 3 3	1 2 1 2 1 2	3	2	11 1 11	5 5 7	11	3 4 4 5 5	2		
4	2	2		3	11	5	12	*	2		
5	3	1	+	2	12	7	12	5	3		
0	5	,2	•	3	12	7	2	5	3		
7	+	1 2	. ;	2 3 2 3 2 3 2 3	1 12	10	12	7	1 2 2 3 3 3		
6 7 8 -1	•	2	,	3	12	10	2	,	3		
1	9.91										

- month of the whole of the table one has a finder who will

	FLESH	3 -	F	INOCYL	(II)						
5	3	10	5	1.1		5					
	0.3		(.3	0	Û		0.0		0.0	3.3	0.0
	3.)		0.)	1	ü		0.0		0.0	0.0	0.0
	0.0		0.1	0	C		0.0		0.0	C . C	ű. Ü
	3. 3		3.1	2	C		0.6		Ú . B	ů · ū	96.6
	0.1		0.;		96		0 - 1		7.1	0.0	96.6
	0.)		6.3	4	96	Û.	.939		933	9.0	96.0
	0.3		0.)	5	90	1	.189		139	0.0	90.0
	0.0		0.1	7	90		.147		1+7	3.6	96.0
	0.3		0.)	8	90		. 347	2.	3+7	ū • C	90.0
	0.3		0	10	96	2	.447	2.	++7	0.0	90.0
	0.1 7285		0.1	0	C		0.0		3.3	0.0	0.0
1.1	7285	0.	195	11	0		0.0		C	0.0	0.6
	0.3	ů.	195	G	C		0.6		0.0	9 . C	C . 0
	3.0		195	12	C		0.6		3.0	. ú	6.6
1	1	1	1	3							
1 2 3 3 3	1 2 3	1	1 2 3	3 3 3 3 2 2							
3	3	1	3	3							
3	5	1 1 2 1	; ; ;	3							
3	,	1	,	3							
2 3	1	1	2	2	1	4	11	3	2		
2	1	2	3		11	4	2	3	2		
	2	1	3	2	1	5	11	4	3		
4 5 6 7	2 2 3 3	2	3	2 3 2	11	5	12	4	3		
5	3	1	•	2	1		12	5	3		
6		2	+	3 2	12	7	2	5	3		
7	+	2 1 2	;	2	1 12	10	12	7	2 2 3 3 3 3 3 3 3		
. 8	•	2	,	3	12	10	2	7	3		
-1											
	9.91							_			
2 3	1 2 2 3	1 2 1 2 1	2 2 3	2 3 2	1	4	11	3	2		
2	1	2	?	3	11	4	2	3	2		
	2	1		2	1	5 7	11	4	3		
4	2	2	3	3	11	5	2	*	3		
5	3	1		2	1	7	12	5	3		
6 7 8	3	2	•	2 3 2 3	12	7 10	12	7	2 2 3 3 3 3 3 3 3 3		
,	+	1	;	2	1	10	12	7	3		
8	•	2	,	3	12	10	2	7	3		
-1											
51	.095										

1	1	1	?	2	1	4	11	3	5
2	1	2	2	3	11	4	2	3	2
3	5	1	. 3	2	1	5	11	4	3
4	5	2		3	11	5	2	4	3
5	3 4	1 2 1 2 1 2 1 2	• • • •	2 3 2 3 2 3 2 3	1 11 11 11 12	4. 5 7 7	11 2 11 2 12 2 12 2	3 4 4 5 5 7 7	3 3 3 3 3 3
Ó	3	2		3	12	7	2	5	3
7	4	1	5	2	1 12	10	12	7	3
8	+	2	,	3	12	10	2	7	3
-1									
+2.	335								
1	1	1	2	2	1	4	11	3	2
2	1	2	2	3	11		2	3	2
3	2	1	3	2	1	5	11	4	3
4	1 1 2 2 3 3 4 +	1 2 1 2 1 2 1 2	2 2 3 4 4 5 5 5	2 3 2 3 2 3	1 11 1 11 12 1 12	5 5 7 7 10	11 2 11 2 12 2 12 2	3 3 4 5 7 7	2 2 3 3 3 3 3 3
5	3	1		2	1	7	12	5	3
6	3	2		3	12	7	2	5	3
7	+	1	5	2	1	10	12	7	3
8	+	2	,	3	12	10	2	7	3
-1									
53.	585								
1	585 1 1 2 2 3 3	1	?	2	1	4	11	3	2
2	1	1 2 1 2 1 2 1 2	3 + + ; ;	2 3 2 3 2 3	11	4	11 2 11 2 12 2 12 2	3 3 4 4 5 5 7 7	2 3 3 3 3 3 3
3	2	1	3	2	1	4 5 7 7 8 8	11	4	3
4	2	2	3	3	11	5	2	4	3
5	3	1	+	2	1	7	12	5	3
ó	3	2		3	12	7	2	5	3
7	+	1	j	2	1	8	12	7	3
8	4	2	j	3	1 11 11 11 12 1	8	2 .	7	3
-1									
123 +5 67 81 2. 2. 45 67 81 23 45 67 81 64.	835								
END									

CARD I. TITLE.

FLESH3 - FINOCYL (I)

CARD II. CONFROL.

IMAX JMAX NNC IBC SCALE NLAY
5 3 10 7 1. 3

CARD III. PART BOUNDARY CURVE.

x -	30050 A	- COORD	NN	NP	A (-AKIS	B Y-AXIS	THETAI	THETAF
	0.030	0.000	G	G	0.60339	0.00600	0.00000	0.00003
	3.000	0.000	1	0	0.00000	6.00000	0.00000	0.00000
	0.000	6.000	a	e	0.00036	0.00000	0.00008	0.00000
	3.011	3.000	2	0	0.06333	6.03600	0.00000	0. C000:
	0.000	0.000	3	90	. 10030	. 10000	0.00000	90.00000
	0.000	0.000	4	90	. 93980	.93900	0.00000	90.00000
	0.010	e. e o o	5	9 €	1,18900	1.13900	0.00000	96.00000
	3.030	L. 000	7	90	2.14760	2.14700	0.00000	90.00001
	0.030	6.000	8	90	2.34700	2.34700	0.00000	30.00000
	0.010	0.000	9	90	2.43300	2.43300	0.00000	90.00000
	0.010	0.060	0	0	0.00000	3.00000	0.00000	0.00009
	1.173	. 195	11	0	0.00000	0.00000	C. 06C00	6.00303
	0.000	. 195	8	G	0.68938	0.06000	0.00000	0.00003
	3.030	. 195	12	0	0.00013	0.0000	0.00000	0.00000

CARD IV. NODE CODE SEQUENCE.

when the second to be a sold and the second with the

IC	[1	JI	15	12
1	1	1	1	3
1	2	2 1 2 1 3	2	3
1	2 2 3	1	3	1
2	3	2	3	3
2	4	1	4	2
1 1 2 2 3 3	4	3	5	1 3 2 3 2
3	5	1	5	2

CAR) V.	PART	DEFI	NII	TON-

NP	I1	Jı	12	12	L1	F5	L 3	L4	HT	HH	13	U3	15
1	1	1	2	2	1		11	3	1	- 0	-0	-3	- 0
2	1	2	2	3	11		2	3	1	-0	-0	-8	- 0
3	2	1	3	2	1	5	11	4	1	-0	-0	-0	- 0
4	2	2	3	3	11	,	2	4	2	-0	-0	-8	- 0
5	3	1	4	2	1	7	12	5	2	-0	-0	-0	- G
ó	3	5		3	12	7	2	5	3	-0	-0	-3	- 3
7	4	1	5	2	1	3	12	7	3	-0	-0	-0	- 0
8	4	2	5	3	12	3	2	7	3	-0	-0	-1	- 0
- 1	- 0	- G	-0	-0	-0	-)	- 0	-0	-0	-0	-0	-0	- 0

The second series and the second second

Z - C0030

*	•		Z	HT
1	.10366	0.00066	0.00000	1
2	.93900	0.00000	0.00000	1
3	1.18900	0.00000	0.00000	1
4	2 . 147 00	0.00000	6.60000	2
5	2.34700	6.00000	0.00000	3
6	.09864	.31646	0.60300	1
7	. 92625	.15400	6.60000	1
8	1.17286	.19500	G.00000	2
9	2.13807	.19500	0.60000	2
10	2.33882	.19500	0.00000	3
11	.07071	.37371	6.00000	1
12	.66397	. 56397	0.60000	1
13	. 84075	. 34075	0.0000	2
14	1.51816	1.51816	6.00000	3
15	1.65958	1.55958	0.00000	3

CARD V. PART DEFINITION.

19	I 1	J1	12	12	L1	L?	_ 3	L4	HT	NN	13	U3	13
1	1	1	2	2	1		11	3	1	-0	-0	-0	- 2
2	1	2	2	3	11		2	3	1	- 0	-0	-3	- 3
3	2	1	3	2	1	5	11	4	1	-0	-0	-0	- 3
4	2	2	3	3	11	,	2	4	2	-0	-0	-3	- 0
5	3	1	4	2	1	7	12	5	2	-0	-0	-0	- 0
6	3	2	4	3	12	7	2	5	3	-0	-0	-0	- 3
7	4	1	5	2	1	3	12	7	3	-0	-0	-ū	- :
8	4	2	5	3	12	3	2	7	3	-0	-0	-0	- 0
- 1	- 3	-6	-0	- 0	-0	-1		-0	- 0	- 0	-0	-0	- 3

# SARD VI. SECTION LOCATION.

Z - 30020

4	(	Y	Z	HT
16	. 10000	6.30006	6.13000	1
17	. 93900	0.30000	8.13000	1
18	1.13900	0.00006	8.13000	1
19	2 . 1 +7 00	0.00006	8.13000	2
20	2.43300	0.30006	8.13000	3
21	. 19864	. 31646	8.13000	1
22	.92525	. 15400	8.13000	1
23	1.17286	.19500	8.13000	2
24	2.13807	.19500	8.13000	2
25	2.+2508	.1950U	8.13000	3
26	.07071	.07071	8.13600	1
27	. 56397	. 66397	8.13000	1
28	. 34075	.34075	8.13000	2
29	1.51816	1.51816	8.13000	3
30	1.72039	1.72339	8.13000	3

CARD	PART	DEET	MTT	MOT
LARI	PACI	UFFI	MI I	

46	[1	J1	12	J2	LI	rs	L 3	14	HT	HH	13	33	15
1	1	1	2	2	1		11	3	1	-0	-0	-3	- 3
2	1	2	2	3	11		2	3	1	-0	-0	-0	- 0
3	2	1	3	2	1	5	11	4	1	-0		-0	- 0
4	2	2	3	3	11	5	2		2	-0	-0	-0	- B
5	3	1	4	2	1	,	12	5	2	-0		-0	- 3
6	3	- 2	- 4	3	12	7	2	5	3	-0	-0	-0	- 0
7	4	1	5		1	3	12	7	3	-0	-0	-0	- 3
8	4	2	5	3	12	9	2	7	3	-0	-0		
- 1	-0	-0	-0	- 0	-0	-)	- 3	-0	-0	-0	-0	-0	-0

Z - COORD

4		•		Y		Z	HT		
31	. 1	000-	0.3	0006	16.20	6000	1		
32		3900		0000	16 . 2		1		
33		8900		0000	16 . 20		1		
34		+700		3330	16.2		2		
35		3300		0960	16.2		3		
36		9864		1540	16.20		1		
37		2625		5400	16.2		1		
38		7286		9500	16.2		2		
39		38 0 7		9560	16 . 2	6000	2 2 3		
40		2503		95 C U	16.20				
41		7071		7071	16 . 21		í		
42		6397		6397	16.21	6000	1		
43	. 9	4075		4475	16.2		2		
44		1816		1816	16.26		3		
45		20 39		2339	16.20	6000	3		
1	1	2	7	6	16	17	22	21	1
2	2	3	8	7	17	18	23	25	1
3	3	4	9	8	18	19	24	23	1 2 1 2 1 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3
4	6	7	12	11	21	2.5	27	25	1
5	7	8	13	12	22	23	28	27	2
6	16	17	22	21	31	32	37	35	1
7	17	18	23	22	32	33	38	37	1
8	18	19	24	23	33	34	39	38	5
9	21	22	27	26	36	37	42	41	1
10	35	23	28	27	37	38	43	42	2
11	4	5	10	9	19	20	25	24	3
12	8	9	14	13	23	24	29	23	3
13	9	13	15	14	24	25	30	29	3
14	19	5.0	25	24	34	35	40	33	3
15	23	24	29	28	38	39	44	43	3
16	24	25	30	29	39	+ 3	45	4+	3
1	9	8	23	24	1				
2	8	13	28	23	1				
3	24	23	3.8	39	1				
4	23	28	43	38	1				
5	4	9	24	19	1				
6		24	70	71.	•				

CARD I. TITLE.

FLESH3 - FINOCYL (II)

CARD II. CONFROL.

IMAX JMAX NNC IBC SCALE NLAF 5 3 10 5 1. 2

CARD III. PART BOUNDARY CURVE.

-	C0050 A	- COORD	411	NP	A C-AXIS	B Y-AXIS	THETAI	THETA:
	0.036	6.060	0	0	0.00003	0.00000	0.00000	0.00000
	3.000	0.000	1	0	0,00000	0. 60 60 0	0.00000	0.00000
	0.930	0.000	0	0	0.00030	0.00000	0.06000	0.00000
	3.838	3.000	2	0	0.00000	0.00000	0.00000	0.00000
	0.010	6. 300	3	90	. 10000	. 10000	0.00000	90.00000
	0.000	0.000	4	90	. 93900	.93900	0.00000	90.00000
	0 . 0 1 0	0. 6ú6	5	90	1.10960	1.19900	0.00000	90.00003
	0.000	0.000	7	90	2.14700	2.14700	0.00000	90.00000
	0.033	0.660	9	90	2.43300	2. +3300	0.00000	90.00003
	0.000	0.000	10 .	90	2.44700	2.44700	0.00000	90.00000
	0.033	0.000	0	0	0.80836	0.00000	0.00000	0.00008
	1.173	.195	11	0	0.00003	0.0000	0.00000	0.00000
	0.000	. 195	0	0	0.00060	0.00000	0.00000	8.09808
	3.030	.195	12	0	0.00000	0.00000	0.00000	0.00000

CARD IF. NODE CODE SEQUENCE.

the second section and the second second second second second

IC	11	J1	15	12
1	1	1	1	3
1	2	1	2	3
2	3	1	3	3
3	4	1	4	3
3	5	1	5	3

CARD	1.	PART	DEFINITION.

NP.	[1	J1	12	12	L1	r 5	_ 3	L4	MT	NN	13	<b>J</b> 3	15
1	1	1	2	2	1		11	3	1	- 0	-0	-0	- 0
2	1	2	2	3	11		2	3	1	-0	-0	-0	- 3
3	2	1	3	2	1	5	11	4	2	-0	-0	-0	- 3
4	2	2	3	3	11	,	2	4	2	-0	-0	-0	- 9
5	3	1	4	2	1	7	12	5	3	- 0	-0	-0	- 0
6	3	2	4	3	12	7	2	5	3	-8	-8	-6	- 8
7	4	1	5	2	1	•	12	7	3	-0	-0	-0	- 3
8	4	2	5	3	12	9	2	7	3	- 6	-0	-0	- 3
- 1	- 0	-0	-0	-0	-0	-1	- 3	-0	-0	- 0	-0	-3	- 0

we a second production of the second second second

Z - C0020

15.26ú

1	(	4	Z	MT
1	. 1 00 0 5	6.30006	16.26030	1
2	. 9 39 0 3	0.06006	16.26010	1
3	1.18900	0.00000	16.26000	2
4	2.14700	0.00000	16.26000	3
5	2 . + 33 0 0	0.30060	16.26000	3
0	. 39864	.31646	16.26030	1
7	. 32625	. 1540 ú	16.26000	1
8	1.17286	.19500	16.26033	2
9	2.13807	.19506	16.26000	3
10	2.42508	.19500	10. 26 u 0 J	3
11	.07371	.37071	16.26000	1
12	.66397	. 56397	16.26030	1
13	.84075	.34075	16.26000	2
14	1.51816	1.51816	16.26000	3
15	1.72039	1.72039	16.26000	3

CAR) /.	PART	DEFINITION.
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1 P	I 1	J1	12	J2	L1	L?	L 3	L4	HT	NN	13	J3	15
1	1	1	2	2	1		11	3	1	-0	-0	-3	- 8
2	1	2	2	3	11	•	2	3	1	-0	-0	-0	- 3
3	2	1	3	2	1	5	11	4	2	-0	-0	-3	-0
4	2	2	3	3	11	5	2	4	2	-0	-0	-6	- 9
5	3	1	4	2	1	7		5	3	- 0	-0	-0	-0
-6	3	. 5	- 4	3		7	2	- 5	3	-8	-6	-6	- 1
7	4	1	5	2	1	1)	12	7	3	-0	-0	-ú	- 9
8	4	2	5	3	12	1)	2	7	3	-0	-0	-0	-0
- 1	- 0	-0	-0	- 0	-0	-1	- 1	-0	-0	-0	-0	-0	- 3

or a street posts with sign to him me with all would be and

Z - COURD

×		•		Y		Z	HT		
16	.10	0000	6.8	900€	19.9	1000	1		
17	. 93	3980	U. 31	3966	19.9	1000	1		
18	1.15	900	0.0	0000	19.9	1000	2		
19	2.14	700	0.30	0000	19.9	1000	3		
20	2.44	700	0.00	3366	19.9	1000	3		
21	. 39	864	. 31	1640	19.9	1000	1		
22	. 32	2625	. 1	5400	19.9	1000	1		
23	1.17	286	. 1	9500	19.9	1600	2		
24	2.13			9500	19.9		3		
25	2.43	3913	. 1	9500	19.9	1000	3		
26	. 9 7	7671	. 37	7371	19.9	1009	1		
27	• 66	397	. 56	397	19.9	1000	1		
28	. 84	0 75	. 34	+075	19.9	1000	2		
29	1.51	1816	1.5	1816	19.9	1000	3		
36	1.73	30 29	1.73	3329	19.9	1000	3		
1	1	2	7	6	15	17	22	21	1
2	2	3	8	7	17	18	23	22	2
3	6	7	12	11	21	22	27	25	1
4	7	8	13	12	22	23	28	27	2
5	3	4	9	8	18	13	24	23	3
6	4	5	10	9	19	23	25	24	3
7	8	9	14	13	23	24	29	28	3
8	9	10	15	14	24	25	30	29	3
1	3	8	23	18	1				
2		13	28	23	í				

CARD I. TIT-E.

FLESH3 - FINOCYL (III)

CARD II. CONFROL.

IMAX JMAX NNC IBC SCALE NLAY
5 3 10 5 1. 5

CARD III. PART BOUNDARY CURVE.

x -	2005D A	- COORD	HN	NP	A (-AKIS	B Y-AXIS	THETAI	THETAF
	0.036	0.660	0	0	0.06000	6.69990	0.00000	0.00008
	3.030	0.000	1	0	0.00000	0.00000	0.00000	0.00000
	0.000	0.000	0	0	0.00000	0.00000	0.08000	0.00006
	3.011	3.000	2	0	0.00000	8.00000	0.00000	0.00000
	0.000	0.000	3	90	. 10330	. 10000	0.00000	90.00003
	0.000	0.000	4	90	. 93900	.93900	0.00000	90.00000
	0.000	0.000	5	90	1,18900	1.18900	0.00000	90.00000
	0.033	0.000	7	90	2.147.0	2.14700	0.00000	90.00000
	0.036	6.060	8	90	2.34700	2.34700	0.00000	90.00000
	0.030	0.000	10	90	2.44700	2.44700	0.00000	90.00000
	0.030	0.000	0	0	0.00000	0.00000	0.00000	0.00000
	1.173	. 195	11	0	0.00000	C. 00 0 G O	0.00000	0.00003
	0.030	. 195	0	0	0.00000	6.00000	0.00000	0.00000
	3.000	.195	12	0	0.00000	0.00000	6.00000	6.00000

CARD IV. NODE SODE SEQUENCE.

and the state of t

10	[1	J1	12	12
1	1	1	1	3
1 2	2	1	2	3
3	3	1	3	3
3	4	1	4	3
3	5	1	5	3

CAR) V.	PART	DEFINITION.
---------	------	-------------

1P	11	J1	12	12	L 1	rs.	_ 3	L4	HT	NN	13	13	12
1	1	1	2	2	1		11	3	2	- 0	-0	-c	- 3
2	1	2	2	3	11		2	3	2	-0	-0	-0	- 8
3	2	1	3	2	1	5	11	4	3	- 0	-0	-0	- 0
4	2	5	3	3	11	5	2	4	3	-0	-6	-0	- 3
5	3	1	4	2	1	7	12	5	3	-0	-0	-0	- 3
6	3	2	4	3	12	7	5	- 5	3	-0	-0	-0	- <del>0</del>
7	4	1	5	2	1	11	12	7	3	- 0	-0	-3	-0
8	4	2	5	3	12	13	2	7	3	- 0	-0	-0	- 0
- 1	-0	-0	-0	- 0	- 0	-1	- 8	-0	-0	-0	-0	-0	-0

z - 00030

*	Y	2	MT
.10000	6.00000	19.91000	1
.93900	0.00000	19.91000	2
1.18900	0.00006	19.91000	3
2 . 147 00	0.00000	19.91000	3
2 . 44780	0.36066	19.91003	3
.09864	.01540	19.91030	1
.92625	. 15400	19.91000	2
1.17286	.135Gú	19.91303	3
2.13807	.19500	19.91000	3
2.43913	.19500	19.91000	3
.07071	. 37371	19.91000	1
. 56397	. 66397	19.91000	2
.84075	. 34075	19.91030	3
1.51816	1.51816	19.91000	3
1.73029	1.73329	19.91000	3
	.10000 .93900 1.18900 2.14700 2.44700 .09864 .92625 1.17286 2.13807 2.43913 .07071 .66397 .84075 1.51816	.10000	.10000

CAR) (.	PART	DEFINITION	

1P	I 1	J1	12	12	L 1	r;	_ 3	L4	MT	NN	13	13	15
1	1	1	2	2	1		11	3	2	-0	-0	-0	- 0
2	1	2	2	3	11		2	3	2	-0	-0	-0	- 0
3	2	1	3	2	1	5	11	4	3	-0	-0	-0	- ;
4	2	2	3	3	11	5	2	4	3	-0	-0	-3	- G
5	3	1	4				12			- 0			- 3
ô	3	2	4				2						
7	4	1	5		1	1)			3		-0		- 0
9	4	2	5	3	12	1)	2		3	-0		-	- 3
- 1	- 3	-0	-0			- 1		-0	- 0		-0		

The state of the state on the to the second state of the second sections

Z - GOORD

٧	<	Y	Z	HT
16	.10000	0.00000	31.08500	1
17	.93903	0.00000	31.08503	2
18	1.18900	0.30000	31.08500	3
19	2.14703	0.00000	31.08500	3
20	2.+4700	0.00000	31.08500	3
21	.0 9864	.01646	31.08500	1
22	. 9 26 25	.15400	31.68500	2
23	1.17286	.1950ú	31.08500	3
24	2.13807	.19500	31.08500	3
25	2 . 4 3 9 1 3	.19500	31.0850J	3
26	.07071	.37071	31.08500	1
27	. 56397	.56397	31.68500	2
28	. 54075	.34075	31.08500	3
29	1.51816	1.51816	31.08500	3
3 G	1.73029	1.73029	31.08500	3

CARD V. PART (	DEFINITION.
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1P	[1	J1	12	12	L1	r:	L 3	L4	HT	NN	13	<b>J</b> 3	13
1	1	1	2	2	1		11	3	2	-0	-0	-6	- 0
2	1	2	2	3	11		2	3	2	- c	-8	-6	- 9
3	2	1	3	2	1	5	11	4	3	-0	-0	-3	- 5
4	2	2	3	3	11	5	2	4	3	-0	-0	-0	- 3
5	3	1	4	2	1	7	12	5	3	-0	-0	-0	- 0
6	3	2	4	3	12	7	5	- 5	3	-0	-0	- 1	- 4
7	4	1	5	2	1	11	12	7	3	-0	-0	-0	- 0
8	4	2	5	3	12	1)	2	7	3	- G	-0	-0	- 3
- 1	- 0	-6	-0	-0	-0	- 3	- 0	-0	-0	- 0	-0	-0	- 0

In the second said that early to have me had a surround by their

Z - CU020

4	(	Y	Z	MT
31	. 10000	0.00000	42.33500	1
32	.93900	0.30000	42.33530	2
33	1.18900	6.06606	42.33500	3
34	2.14700	6.00000	42.33500	3
35	2 . + +700	0.06066	42.3350J	3
36	. 39864	.01640	42.33510	1
37	. 3 26 25	.15400	42.33510	2
38	1.17286	.19500	42.33500	3
39	2.13887	. 19500	+2.33500	3
40	2.43913	.19500	42.33501	3
41	.07071	.37071	42.33500	1
42	.66397	.56397	+2.33500	2
43	. 84075	. 34475	42.33500	3
44	1.51815	1.51816	42.33500	3
45	1.73029	1.73029	42.33500	3

	CARD	1.	PART	DEFINI	TICN.
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19	11	JI	12	12	LI	L?	_ 3	L4	HT	NN	13	33	15
1	1	1	2	2	1		11	3	2	-0	-0	-0	- 0
2	1	2	2	3	11			3	2	- 0	-0	-0	- 9
3	2	1	3	2	1			4	3	- 0	-0	-0	- 5
4	2	2	3	3	11	5	2	4	3	-0	-0	-0	- 3
5	3	1	4	2	1	7		5	3	-0	-0	-0	- 0
5	3	2	4	3	12	7	2	5	3	-0	-0	-0	- 8
7	4	1	5	2	1	1)	12	7	3	-0	-0	-0	- 0
8	4	2	5	3	12	1)	2	7	3	-0	-0	-0	- 3
- 1	- 1	-6	-0	- 0	-0	-1	<b>-</b> 0	-0	-0	- 0	-0	-6.	- 0

The second second second second second second second second second second

Z - 200 RD

4	•	٧	Z	HT
46	.10000	0.10066	53.58500	1
47	. 33900	0.30000	53.58500	2
48	1.18900	0.30300	53.58500	3
49	2.14705	0.00300	53.58500	3
50	2.44700	6.30066	53.58500	3
51	.09864	.01640	53.58503	1
52	. 9 26 25	. 15406	53.58500	2
53	1.17280	.19500	53.58500	3
54	2.13807	.19500	53.58500	3
55	2.43913	.19500	53.58500	3
56	.07071	.07071	53.58500	1
57	.66397	. 56397	53.5850J	2
58	. 84075	. 94075	53.58500	3
59	1.51816	1.51816	53.58500	3
60	1.73029	1.73029	53.58500	3

CARD	4.	PART	DEFINIT	TON.

NP.	[1	J1	12	12	L1	r ;	_ 3	L4	HT	NN	13	J3	13
1	1	1	2	2	1		11	3	2	- 0	-0	-0	- 0
2	1	2	2	3	11		2	3	2	-0	-0	-0	- 0
3	2	1	3	2	1	5	11	4	3	- 0	-0	-0	- 0
4	2	5	3	3	11	5	2	4	3	-0	-0	-G	- 9
5	3	1	4	2	1	7	12	5	3	-0	-0	-0	- 0
0	3	2	4	3	12	7	2	5	3	- 0	-0	-0	- 8
7	4	1	5	2	1	8	12	7	3	- C	-0	-0	- 0
8	+	2	5	3	12	3	2	7	3	-0	-0	-)	- 3
- 1	-3	-0	-0	- 0	-0	-)		-0	-0	-0	-0	-:	- 0

Z - CUORD

4		•		Y		Z	HT		
61		0000	0.0	0000	E4.8	3500	1		
62		3900		0000	64.8		2		
63		890ú		0000	64.8		3		
64		+7 û ü		0000	64.8		3		
65		4788		0000	64.8		3		
66		9864		1640	64.8		1		
67		26 25		5400	64.8		2		
68		7286		9500	04.8		3		
69		3807		9500	64.8		3		
70		3882		9500	£4.8		3		
71		7071	. 3	7071	64.8		1		
72	. 6	6397	. 5	6397	64.8	3500	2		
73	. 84	4075		4375	04.8	3510	3		
74		1816		1816	64.8	3500	3		
75	1.6	5958	1.6	5958	64.8	3500	3		
1	1	2	7	b	16	17	22	21	2
2	6	7	12	11	21	22	27	26	2
3	16	17	22	21	31	32	37	35	2 2 2 2 2 2 2 3 3
4	21	22	27	26	36	37	42	41	2
5	31	32	37	36	46	47	52	51	2
Ö	36	37	42	41	51	52	57	55	2
7	+6	47	52	51	€1	50	67	5 ò	2
8	51	52	57	56	66	5 7	72	71	5
9	2	3	8	7	17	18	23	22	3
10	3	4	9	8	18	19	24	23	3
11	4	5	10	9	19	20	25	24	3
12	7	8	13	12	22	23	28	21	3
13	8	9	14	13	23	24	29	28	3
14	9	10	15	14	24	25	30	29	3
15	17	18	23	22	32	3 3	38	37	3
16	18	19	24	23	33	3 +	39	38	3
17	19	20	25	24	34	35	40	39	3
18	5.5	23	28	27	37	3 8	43	42	3
19	23	24	29	28	38	39	44	43	3
20	24	25	30	29	39	40	45	4+	3
21	32	33	38	37	47	48	53	52	3
22	33	34	39	38	48	+9	54	53	
23	34	35	40	39	49	50	55	5+	3
24	37	38	43	42	52	53	58	57	3
25	38	39	44	43	53	5+	59	58	3

and the state of t

1 3	_ 5_	3								
45	10	6	6	0	1					
1		9000	0.00	900			- 1			
2	.93	1900	0.00		0.0		1			
3	1.1		-	1000			1			
4	2.14			000		0000	2			
,	2.34			000		0010	3			
6		864		640	-	8030	1			
7		25 25		1408		***				
8	1.17		100	508			2			
9						0000	2			
		39 9 7		500		0000				
10	2.3			3500		6800	3			
11		7071	-	1071		0000	1			
12	-	53 97		397			1			
13		+075		1075		0000	2			
14	1.51			816	200	0000	3			
15	1.6		(1997)	958		0000	3			
16		0000		0000		3030	1			
17		390G	0.00	999	8.1	30 0 <b>0</b>	1			
18	1.18	3900	0.00	0000	8.1	3000	1			
19	2.14	+7 <del>00</del>	0.00	000	0.1	3000	- 2			
20	2.43	3300	0.00	0000	6.1	3000	3			
21		3864		640	8.1	3000	1			-
22	. 32	26 25	. 15	400	8.1	3000	1			
23	1.17	286		500		3000	2			
24	2.13			500	8.1	3000	2			
25	2.41			500	100000000000000000000000000000000000000	3000	- 3			
26	-	7071		071		3000	1			
27		397		397		3000	i			
28		0 75		075	1000	3000	2			
	1.5	-			100,100	3000	3			
29	1.7			816		3000	3			
30		0.0000		20 39						
31		90 00		000	16.2		- 1			
32		3900		0000	16.2		1			
33	1.1			000	16.2		1			
34	2.14			0000	16.2		2			
35	2.4			000	16.2		3			
36		9864		1640	16.2		1			
- 37		26 25		400	16.2					
38	1.17			500	16.2		2			
39	2.1			500	16.2		2			
40	2.43	2508	. 19	3500	16.2	6088	3			
41	.07	7071	.07	071	16.2	6000	- 1			
42	. 66	397	. 56	397	16.2		1			
43	84	+075		1075	16.2	6000	- 2			
44	1.51	1816	1.51	816	16.2	6080	3			
45	1.73	20 39	1.72	2039	16.2	6000	3			
1	1	2	7	6	15	17	22	21	1	
- 5	5	3	- 8 -	7	17	18	23	55	1	
3	3	4	9	8	18	19	24	23	2	
	6-	7	12	-11	- 21	56	27	25		
5	7	6	13	12	22	23	26	27	2	
6	16	17	55	- 21	31	32	37	35	1	
7	17	18	23	22	32	33	38	37	i	
- 6	10	19	24	53	33	34	39	38	5	
9	21	22	27	26	35	37	42	41	i	
10	55	<del>23</del>	20	27	37	31	43	42		
11	4	5	10		19	20	25	26	3	
		9		13	23	24	29	28	3	
12			14						3	
	9	10	15	14	24	25	30 46	39	3	
							14.15			
14	23	24	25 29	24	38	39	44	43	3	

1	9	8	23	24	1				
2	8	13	28	23	1	-			
3	24	23	38	39	1				
5	23	28	43	38 19	1				
- 6	19	24	39	34	i				
30	4	4	2	3	]				
1		9000		0000		6000	1		
2		3900		0000		6000	1		
3	1.1			0000		6000	3		
	2.1			0000 0000		6000	- 3		
6		9864		1640		6000	1		
7		26 25		5400	16.2	6000	1		
8		7286		9500		6000	2		
9	2.1			900		6000	3		
10		2508 7071		7071		6000	3		
1.2		5397		6397		26000	i		
13		0 75		075		6000	2		
14	1.5		1.5	1816		6004	3		
15	1.7			20 39		6000	3		
16		0000		0000		1000	1		
17	1.1	<del>1900</del>		0000		1030	ž		
19	2.14			0000		1000	3		
20		700		0000		1000	3		
21		9864		640		1000	1		
22		26 25		5400		1000	1		
<del>23</del> 24	2.13	72 86 38 0 7		9500 9500		1000	3		
- 25		913		500		1000	3		
26		7071		7071		1000	1		
27		5397		6397		1000	1		
28		075		175		1000	2		
29	1.73	816		816		1000	3		
30	1	5 29	7	6 9	16	17	55	21	1
2	ž	3	8	7	17	18	23	22	ž
3	6	7	12	-11	21	55	27	25	1
4	7	8	13	12	22	23	28	27	2
	-3-	-	- 9		10	19	24	-23	3
- 6 7		9	10	13	19 23	50	25	25	3
8	9	10	15	14	24	25	30	23	3
i	3	8	23	10					
_ 2	8	13	28	23	. 1				
75		24	- 8	- 5	1			-	
1 2		10 00 1 <del>9 00</del>		3000		1000	1 2		
3	1.18			0008		1000	3		
	2.14			000		1000	3		
5	2.44	700	0.00	0000	19.9	1800	3		
	-	9864		640		1880			
7		2625	• • • •	5400	19.9	1000	3		
9		38 87		9500		1000	3		
- 10	2043			500		1000	3		
11		7071		071		1800	1		
12		397		397		1000			
13		075		075		1000	3		
14	1.73			1816 1029		1000	3		
15	100000000000000000000000000000000000000	10 00		1000		8500	-1		
17		900		000		8500	2		
18	1.10			000		8500	3		

		Owner or and		and the second					
19	2.14	700	0.00	0000	31.0	8500	3		
20	2.44	700	0.01		31.0	9500	3		
21		864		1640	31.0		1		
22	.92	6 25	. 1	5400	31.0	858 0	5		
23	1.17	286	. 1	9500	31.0	850 0	3		
							3		
	2.13			9500	31.0				
25	2.43	3913	.19	9500	31.6	850 0	3		
26	- 01	17071	-0	7071	31.0	4500	1		
27		397	. 0	6397	31.0		2		
28	. 84	075	. 31	1075	31.0	858 B	3		
29	1.51	816	1.51	1816	31.0	8500	3		
3ú	1.73	70 29		39 29	31.0	028.0	- 3		
31	. 10	<b>30 0</b> 0	0.01	0000	42.3	350 O	1		
32	. 91	900	0.00	0000	42.3	350 0	2		
						-			
33	1.18		0.01	0000	42.3	3500	3		
34	2.14	700	0.00	000	42.3	3588	3		
35	2.44	700	0.01	0000	42.3	358 0	3		
36	.09	3864	. 0	1640	42.3	3700	-1		
37	. 32	2625	. 1	5400	42.3	3500	2		
38	1.17			9500	42.3		3		
39	2.13			9500	42.3		3		
40	2.43	913	.11	9500	42.3	3500	3		
+1		7071		7071	42.3		1		
42		397	. 51	6397	42.3		5		
43	. 84	+075	. 34	4075	42.3	3500	3		
44	1.51			1816	42.3		3		
45	1.73	50 29	1.7	3029	42.3	350 U	3		
46	.16	0000	0.0	0000	53.5	8500	- 1		
47		3900		0000	53.5		2		
					100000000000000000000000000000000000000				
48	1.16	3300	0.01	9999	53.5	8588	- 3		
49	2.14	7 00	0.0	0000	53.5	8500	3		
50	2.44			9966	53.5		3		
51		3864	. 0	1640	53.5	8500	1		
52	.92	26 25	. 15	5400	53.5	8588	2		
53	1.17			9500	53.5		3		
54	2013	5007		9500	53.5	858 U	3		
55	2.43	3913	. 1	9500	53.5	8500	3		
<del>- 36</del>		7071					1		
				7071	53.5				
57	. 56	3397	. 5	6397	53.5	8508	2		
58		0 75	- 446	4075	53.5	8588	3		
59	1.51			1816	53.5		3		
60	1.73	<del>50 29</del> -	1.7	30 29	53.5	858 B	3		-
61	- 10	0000	0.00	0000	64.8	3500	1		
62		900		000	64.8		2		
63	1.18	900	0.00	3690	64.8	3500	3		
64	2.14			0000	64. 8		3		
65	2.34			3000	64 . 8		3		
66	.09	1864	.01	1640	64.0	35 0 0	1		
67	.92	625	. 1 0	5400	64.8	3500	2		
68	1.17			500	64.8		3		
69	2.13	5807	. 19	9500	64.8	3500	3		
70	2.33	5888		9500	64 . 6		3		
71		071		7071	64.8		1		
<del>72</del>	•6€	397	- + 6	<del>5397</del> -	64.8	3500	5		
73	. 84	075	. 84	+075	64 . 8	3500	3		
		-							
74	1.51				64 . 8		3		
75	1.65			5958	64.8	35 Q Q	. 3		
1	1	5	7	6	16	17	55	15	?
2	6	7	12			22	27	25	2
				11	21				-
	16	17	- 55	21	31	32	37	35	5
4	21	22	27	26	36	37	42	41	,
- 5	31	32	37			+7	52	51	-
,				36	46				=
6	36	37	42	41	51	52	57	55	2
7 8	+6	47	52	51	61	62	67	55	2 2 2 2 2 2 2 2 3
	51		57			57	72	71	,
•		52		56	66				2
9	2	3	8	7	17	18	23	2 ?	7

10	3	4	9	8	18	19	24	23	3	
11	4	5	10	9	19	20	25	24	3	
12	7	8	13	12	22	23	28	27	3	
13	8	9	14	13	23	24	29	28	3	
14	9	10	15	14	24	25	30	23	3	
15	17	18	23	22	32	33	38	37	3	
16	18	19	24	23	33	34	39	38	3	
17	19	20	25	24	34	35	40	39	3	
18	22	23	28	27	37	38	43	42	3	
19	23	24	29	28	38	39	44	43	3	
20	24	25	30	29	39	40	45	44	3	
21	32	33	38	37	47	- 48	93	52	- 3	
22	33	34	39	38	48	+9	54	53	3	
23	34	35	40	39	49	50	55	54	3	
24	37	38	43	42	52	53	58	57	3	
25	38	39	44	43	53	54	59	58	3	
26	39	40	45	44	54	55	60	59	3	
- 27	+7	48	-53	- 52	62	63	68	67	- 3	
28	+8	49	54	53	63	64	69	5.8	3	
29	+9	58	55	54	64	65	70	59	3	
30	52	53	58	57	67	5.8	73	72	3	
31	53	54	59	58	68	59	74	73	3	
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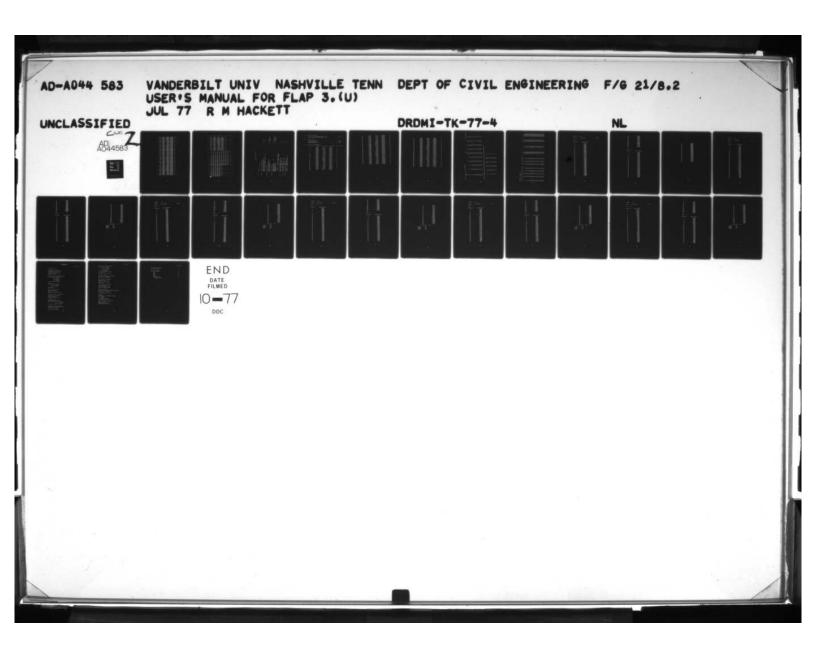
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65	.09	854	.016	40	31.	08500	1			
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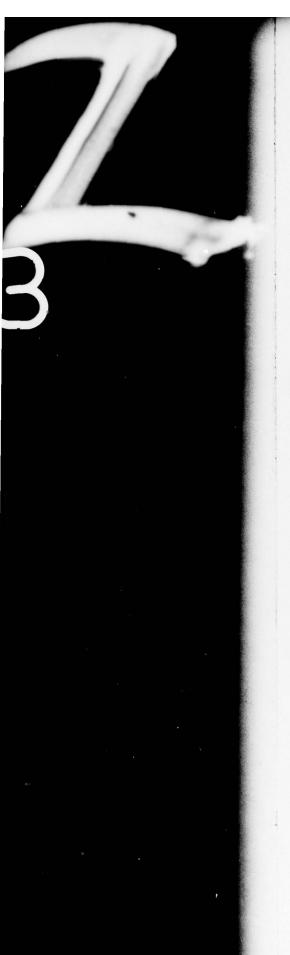
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4	2.14700	0.00000	0.00000	2
5	2.34700	0.00000	0.00000	3 1 1
6	. 09864	.01640	0.0000	
7	.92625	.15400	0.33000	
8	1.17286	.19500	0.00000	2
9	2.13807	.19500	0.00000	
10	2.33882	.19500	0.00000	3
11	.07071	.07071	0.00000	1
12	.66397	.66397	0.00000	1
13	. 84075	.84075	0.00000	2
14	1.51816	1.51816	0.00000	
15	1.65958	1.65958	0.00000	3
16	.10000	0.00000	8.13000	1_
17	.93900	0.00000	8.13000	1
18	1.18900	0.00000	8.13000	1
19	2.14700	0.00000	8.13000	2
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21	. 09864	.01640	8.13000	1
22	.92625	.15400	8.13000	1 2
23	1.17286	.19500	8.13000	2
24	2.13807	.19500	8.13060	
25	2.42508	.19500	8.13000	3
26	.07071	.07071	8.13000	2 3 1
27	.66397	.66397	8.13000	1
28	.84075	.84075	8.13000	2
29	1.51816	1.51816	8.13000	3
30	1.72039	1.72039	8.13000	- 3
31	.10000	0.00000	16.26000	1
32	.93900	0.00000	16.26000	3 1 1 2
33	1.18900	0.00000	16.26000	2
34	2.14700	0.00000	16.26000	2
35	2.43300	0.00000	16.26000	3
36	.09864	.01640	16.26000	1
37	.92625	.15400	16.26000	1
38	1.17286	.19500	16.26000	2 2
39	2.13807	.19500	16.26000	2
40	2.42508	.19500	16.26000	3
41	.07071	.07071	16.26000	1
42	.66397	.66397	16.26000	1 2
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49	2.14700	0.00000	19.91000	3
50	2.44700	0.00000	19.91000	3
, 51	.09864	.01640	19.91000	1
52	.92625	.15400	19.91000	2
53	1.17286	.19500	19.91000	2
54	2.13807	.19500	19.91000	3
55	2.43913	.19500	19.91000	3
56	.07071	.07071	19.91000	1
57	.66397	.66397	19.91000	2
58	.84075	.84075	19.91000	2
59	1.51816	1.51816	19.91000	3
60	1.73029	1.73029	19.91000	_ 3
61	.10000	0.00000	31.08500	1
62	.93900	0.00000	31,08500	2
63	1.18900	0.00000	31.08500	3
64	2.14700	0.00000	31.08500	3
65	2.44700	0.00000	31.08500	3
66	.09864	.01640	31.08500	- 7
67	.92625	.15400	31.08500	2
68	1.17286	.19500	31.08500	
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73	2.43913	.19500	31.08500	- 3
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76	.10000	0.00000	42.33500	1
77	.93900	3.00000	42.33500	2
78	1.18900	0.00000	42.33500	3
79	2.14700	0.00000	42.33500	3
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81	.09864	.01640	42.33500	ī
82	.92625	.15400	42.33500	2
83	1.17286	.19500	42.33500	3
84	2.13807	.19500	42.335110	3
85	2.43913	.19500	42.33500	3
86	.07071	.07071	42.33500	1
87	.66397	.66397	42.33500	2
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89	1.51816	1.51816	42.33500	3
90	1.73029	1.73029	42.33500	. 3
91	.10000	0.00000	53.58500	1
92	.93900	0.00000	53.58500	_ 2
93	1.18900	0.00000	53.58500	3
94	2.14700	0.00000	53.58500	3
95	2.44700	0.00000	53.58500	3
96	.19864	.01640	53.58500	1
97	.92625	.15400	53.58500	2
98	1.17286	.19500	53.58500	3
99	2.13807	.19500	53.5851111	3
100	2.43913	.19500	53.58500	3
101	.07071	.07071	53.58500	1

102	. 6	6397	. 6	6397	53.5	8500	2			
103		4075	. 8	4075	53.5	8500	3			
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106		מממט	0.0	00000	64.8	3500	1			
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108		8900	0.0	10000	64.8	35110	3			
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111		19864		11640	64.8	3500	1			
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113		7286	.1	9500	64.8	35110	3			
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118		4075	. 8	34075	64.8	3540	3			
119	1.5	1816	1.5	1816	64.8	3500	3			
120		5958	1.6	5958	64.3	3500	3			
1	1	2	7	6	16	17	22	21	1	
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3	3	4	9	8	18	19	24	23	2	
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7		18	23	22	32	33	38	37	1_	
â	18	19	24	23	33	34	39	38	2	
9		22	27	26	36	37	42	41	1	
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11		32	37	36	46	47	52	51	1 2	
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16	51	52	57	56	66	67	72	71	2	
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21		92	97	96	106	107	112	111	2	
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11	62	67	82	77	1					
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SECTION SECMETRY IDENTIFIERS.

CARD II.

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CARD I

120 16 16 15 16	= 20.5931 = 1.15000005-37	1.65600000E-04 5.5180.00	<b>ન છ</b> ા # # #	2 -4 LD 2 -4 LD -14
TOTAL NUTBER OF NODES ( NOD ) NUMBER OF INTERFACE SUKFACES ( NIS) NUMBER OF SLOTS ( NSLOT ) ANGLE OF SMALLEST KEPEATING SEGMENT ( ANGLE )	FLUID FRIPERTIES. NUMBER OF FLUID BRICKS (MFB.) BUCK MODILUS (BUCK.) FLUID MASS DENSITY (FDEN.)	SOLID FRIPERILES.  NUMBER OF SOLID BRI'S B 1 SOLID HAS DENSITY 1 STORAGE HODULUS ( GR) LOSS MODJUS ( GR)	HARMONICS (ZERU FOR UNREQUESTED HARMONIC) ZERO HARMONIC (ZHAR) INITIAL ZERO HARMONIC 400E (IZM) LAST ZERO HARMONIC 400E (IZM)	M/2 1AR INITIAL LAST K 1AR INITIAL LAST
	C4RD III.	CAKD IV.	CARO 4.	כגהט עו. כגפט עוו.

CARD IX. COMBUSTION PARAMETERS.

SPEED OF GAS LEAVING THE BURNING SURFACE ( GSPEED ) = 10.00 mass fraction of particulate material ( CCM ) = 0.00

CARD X. RESPONSE FACTORS.

and the second s

 PRISSURE COUPLING ( RPC )
 = 1.003

 VELOCITY COUPLING ( RVC )
 = 1.313

 FLOH TURNING ( RFT )
 = 1.000

 STRUCTURAL DAMPING ( RSD )
 = 1.000

CARD XI. NODES AND THEIR COURDINATES.

NODAL POINT	X - COORDINATE	ETANIOSCCC - Y	Z - COURDINATE	NODE DES	CRIPTION
1	.10003	0.00133	3.00000	1	
2	.93900	9.00000	0.00000	1	
3	1.18900	3.31333	0.00000	1	
	2.14700	0.00000	0.00000	2	
5	2.34733	0.0000	3.00000	3	
6	• 0 98 64	.31543	3.00000	1	
7	. 92 0 25	.15433	0.00000	1	
3	1.17286	.13300	0.00000	2	
9	2.13507	.19500	0. Jūlūu	2	
16	2.33582	.19301	0.00386	3	
11	. 47371	.37071	0.0000	1	
12	.66397	. 55397	0.30000	1	
13	. 84375	. 3 - 0 7 5	0.00300	2	
14	1.51316	1 51815	0.00000	3	
13	1.65958	1.55958	6.0000	3	
16	• 10000	0.33000	8.13:00	1	
17	. 93 900	0.00000	8.13600	1	
18	1.18900	0.00000	8.13000	1	
19	2.14700	0.00030	8.13300	2	
2.	2.43300	6.00000	8.13600	3	
21	• 0 9364	. 11543	8.13660	1	
22	. 92 0 25	.15400	8.13000	1	
23	1. 17286	19505	8.13000	2	
24	2.13897	.19500	8.13:00	2	
25	2.42508	.19500	8.13000	3	
2ć	. 07071	. 07371	8.13000	1	
27	. 06397	. 56397	8.13000	1	
28	. 84075	94075	8.13500	2	
29	1.51816	1.51315	8.13600	3	
30	1.72339	1:72039	8.13003	3	
31	.10000	0.00000	16.26000	1	
32	.93900	0 00000	16.26000	1	
33	1.18900	0.0000	16.26.00	2	
34	2.14700	0.00000	15.26.30	2	

35	2.43300	0.00000	16.26000	3
3 ċ	.09364	.01540	16.2600C	3 1 2 2 3
37	. 92525	.15+00	15.26.00	1
38	1.17296	.19500	16.26000	2
39	2.13007	. 13550	10.26.00	2
40	2.42508	00661.	16.26000	3
41	. 07 171	37971	16.26000	1
42	.66397	. 55397	15.26.00	1
43	. 84375	. 3 - 373	16.26000	2
44	1.51316	1.51915	16.26000	3
45	1.72339	1.72339	16.26080	3
46	. 10000	0.00000	19.91000	1
47	. 9390ú	0.00000	19.91000	2
45	1.18900	0.00000	19.91000	2
	2.14700	0.00000	19.91600	3
49	2.44700	3 36 8 3 6	19.91000	3
50	• 4 98 64	.11541	19.91000	1
51	. 92 6 25	. 15400	19.91600	2
52	1.17286	.19503	19.91000	2
53		.19500	19.91000	3
54	2.13907	19500	19.91.00	3
55	2.43913	. 37371	19.91606	1
56	. 47.71	.55397	19.91600	2
57	• 63 97	.34075	19.91000	2
58	. 84075	1 51815	19.91000	3
59	1.51316	1.73129	19.91000	3
60	1.73729	0.00000	31.08500	1
61	.10000	0.00000	31.08500	2
62	. 93900	0.00000	31.68506	3
63	1.18900		31.08500	3
64	2.14700	0.00000	31.48500	3
65	2.44700	0.00000	31.08500	1
6 É	. 09864	.31543	31.08:00	2
67	. 32625	.15400	31.08500	•
68	1.17286	19500		
69	2.13807	.19533	31.08500	3
7 ù	2.43913	.19500	31.08500	,
71	.07371	. 37 371	31.08500	
72	•66397	55397	31.08500	
73	.84.75	.3-175	31.08:00	3
74	1.51816	1.51816	31.08500	3
7 :	1.73)29	1.73029	31.08500	3
76	.10000	0.00000	-2.33500	11233122331223312333123331233312
77	. 93900	3 00300	42.33500	2

78	1.18900	0.0.000	42.33500	3
79	2.14700	0.00000	42.33500	3
80 .	2.44700	9.00000	42.33500	3
81	.09864	. 31640	42.33500	1
82	• 92 ó 25	.12406	42.3350u	2
83	1.17286	.19500	42.33500	3
84	2.13807	.19590	42.33500	3
85	2.43913	.19500	42.33500	3
85	.07071	. 07 371	42.33500	1
87	•66397	. 3397	42.33500	2
88	. 843 75	. 94975	42.33500	3
89	1.51816	1.51815	42.33500	3
9 û	1.73029	1.73429	42.3350ú	3
91	.10000	0.00000	53.58500	1
92	.93900	0.66000	53.58500	2
93	1.18900	0.0000	53.58500	3
9+	2.14700	0.36060	53.58500	3
95	2.44700	0 00000	53.58500	3
95	• ú 98 64	£31549	53.58500	1
97	• 92625	.15+33	53.58500	5
98	1.17286	.1 = 500	53.58500	3
99	2.13807	.19500	53.58500	3
106	2.43913	.19510	53.58500	. 3
101	.67071	.07371	53.58500	1
102	.66397	. 55397	-53.58500	2
103	. 84075	.84175	53.58500	3
104	1.51816	1 51816	53.58500	3
135	1.73,29	1.73,29	53.58500 64.83500	3
106	.10000	3.00000	64.83500	1 2
107	1.18900	0.36300	64.83500	7
108	2.14700	0.06033	5+.83500	3
109	2.34700	0.06666	64.83500	3
111	. 0 9864	.31543	64.83500	3
111	. 92625	.1>+60	64.83500	2
113	1.17286	19500	64.83500	3
114	2.13617	.19566	64.83500	3
115	2.33182	.13520	64.83500	3
116	.47471	.0,071	64.83500	1
117	.66397	.55397	64.83500	3 3 3 1 2 3 3 3 1 2 3 3 3 1 2 3 3 3 1 2 3 3 3 1 2 3 3 3 3
118	. 84,175	3+375	6+.83500	3
119	1.51316	1.51816	64.83566	3
120	1.65958	1.55938	54.83506	3
	2			

KELATION SHIP.
DON . INS
I. ELLMENT
CARD XII.

and the second second second second second second second

BRICK					NODES				BRICK DE	BRICK DESCRIPTION
•		7		,0	16	1.7	22	5.2	-	
2	2	٣	90	~	17	1.8	23	22	4	
м	8	+	6	<b>6</b> 0	18	1.3	54	23	2	
	9	^	12	11	21	22	27	<b>2</b> c	-	
w	7	<b>40</b>	13	12	22	23	28	27	2	
•	91	1,1	22	21	3.6	32	37	30	7	
	17	87	23	22	32	33	38	37	1	
•	1.6	13	3.4	23	33	34	39	38	2	
•	12	22	2.7	25	36	37	**	1,	-	
10	22	23	2.8	27	37	3.8	M #	2+	2	
11	31	32	37	35	9+	*+	52	70	7	
12	32	33	3.8	3.4	2.0	•	53	33	2	
13	36	37	+5	14	51	20	57	40	1	
1.4	37	33	£ #	4.5	52	70	80 51	A. 45	2	
15	9.	14	52	51	61	5.5	29	5.	2	
16	5.1	55	3.7	35	99	57	7.2	71	2	
17	10	62	5.7	65	7.6	77	92	91	2	
10	99.	67	1.5	71	91	9.5	47	96	2	
19	92	11	82	81	91	35	26	96	2	
50	91	95	97	65	96	7	1:2	131	2	
21	91	95	37	95	106	157	112	111	2	
22	96	26	112	191	111	112	117	110	8	

CARD XIII. QUADRILAFERAL INTERFACE SURFACES AND THEIR NOTES AND SURFACE DESCRIPTION.

-1	~	-	-1	-	-1	-	-	1	-	-	4	-	-1	-1	-
<b>5</b> 2	23	39	3.8	19	34	9.*	53	57	95	77	9.2	35	26	107	112
23	23	3.8	43	2.¢	200	50	91	7.2	19	32	3.7	÷	102	112	117
.0	13	23	28	6	2*	3.8	43	25	52	67	7.2	9.5	87	26	707
•	10	5.	23	•	15	33	38	200	2+	29	19	7.7	82	95	16
-1	2	100	t	ч.	·o	~	10		16	11	12	13	14	15	16

POTENTIAL FLOW ANALYSIS

	21	-831.795	-831.333	- 531. 52;	-831.623	-831.339	-513.792	-614.845	-513.353	-515.323	-514.845	-655.353	-555.885	-553.231	-556.353	-981.341	-881.277	-881.543	-881.341	-530.175	-630.231	-630.19	-530.173	-378.39	-378.12.	-378.343	-378.095	-126.021	-126.327	-126.65!
VELOCITIES	>	-11,624	0.00	0.030	12.33/	0.030	-4.238	5.811	-11.401	-27.200	-9.000	15.500	-2.0.5	9.859	-12.2+0	-5. 231	+54	-5.27+	1.37.	-3.652	-5.27;	-4.413	-+- 613	-1.954	-3.6+5	-3.67+	-3, 952	-1.537	-1.953	-4-55
	× >	-3.8+3		0.63;	-17.021	0.693	5.131	-3.8+	23:	-9.63:	-13.+47	46.32	21.653	32.151	19.435	-1.4+2	.9+3	-2.8+.	• 60	-3.735	-1.321	-4.551	-1.53.	-4.89.	-3. 612	-5.13;	-3.63	-5.33)	-4.8+	-5.631
AREAS			.0		•	•	.0	.0	.0	•				01	•			<b>~</b> 1	01	•	01			•			~	•	n.i	
SURTACE		3. 323	3, 323	. 193	2.951	2.551	3, 323	3. 323	.793	2.351	2.351	.357	.357	1.325	1.325	. 963	. 363	3.204	3.204	.369	.369	3.225	3.225	.359	. 369	3.225	3.225	.369	. 3692	3.225
INTERFACE	¥	or	6	61																									107	
S	3	23	æ	m	23	13	38	23	54	38	28	00	38	53	m .t	62	52	29	25	11	25	82	72	35	32	26	87	101	37	110
NODES	11	54	23		28	•	39	3.8	61	24	23	53	33	9.6	3.8	-57	+7	7.2	3.5	9.5	52	87	5.7	26	77	1,2	9.2	112	26	117
HE IR NODES	•	ď	~	£1	13	23	2.4	1.8	3+	28	33	38	6+	**	53	3.5	5.5	10	2.5	2.5	11	22	20	22 60	36	48	16	16	137	1.12
AND THE IR	_	23	6	3	27	2	33	5.4	13	4.2	22	. 25	32	25	37	69	40	7.1	51	81	19	98	90	96	92	101	18	111	91	116
RAHEDRA	7 1	19	00	5	23	13	34	23	54	3.6	26	*	38	53	۴,	42	5.5	19	2:	7.1	ć.7	8.2	12	25	95	16	28	167	25	112
		54	23	*	28	•	39	38	13	43	23	53	33	96	38	29	1+	72	25	95	95	87	29	16	11	162	82	112	35	1117
INTERFACE		+	2	8	*	S.	9	2								2	9	1	10	6	0	-	2	3	t	2	9	1	2.8	6

FREQUENCY G.000 RAD/SEC

C. COG HZ

SEGMENT 1 R

1	1.00000	
2	1.00000	
3	1.00000	
4	1.06000	
6 7	1.00003	A CONTRACTOR OF STREET
7	1.00600	
8	1.00000	A CONTRACTOR OF THE PROPERTY OF THE PARTY OF
9	1,00000	
11	1.00083	
12	1.00000	
13	1.00000	
16	1.00000	
17	1,06000	
18	1.00000	
19	1.00000	
21	1.00000	
22	1.00000	
23	1.00000	
24	1.00000	
20	1.00000	
27	1.00000	
28	1.00000	
31	1.00000	and the second s
32	1.0000	
33	1.00000	
3+	1.00600	
36	1.00000	
37	1.0000	
38	1.00000	
39	1.00000	
41	1.00000	
42	1.00000	
43	1.00000	
46	1.0000	
47	1.00000	* ·
48	1.00600	
51	1.00000	
52	1.00000	
53	1.00030	
56	1.00000	
57	1.00000	
58	1.00000	
61	1.00000	
62	1.30000	
66	1.00000	
67	1.00000	
71	1.00000	and the second second second second second
72	1.00000	
7 c	1.00600	

77	1.06600
81	1.00000
82	1.00000
86	1.00003
87	1.06000
91	1.00600
92	1.00000
96	1.00000
97	1.0000
101	1.00000
162	1.00000
106	1.00000
107	1.00000
111	1.00000
112	1.00003
116	1.00000
117	1.00000

## SEGMENT 1 L

NODE NU13ER	ACOUSTIC PRESSU	15
1	1.00000	
	1.00000	
2 3	1.00000	
4	1.06660	
0	1.00600	
7	1.00000	
8	1.00000	
9	1.00000	
11	1.06666	
12	1.00000	
13	1.00000	
10	1.00000	
17	1.00000	
1.8	1.00600	
19	1.00000	
21	1.00000	
22	1.00003	
23	1.00600	
24	1,00000	
26	1.00000	
27	1.00000	
28	1.00000	
31	1.00000	
32	1.00000	
33	1.00000	
34	1.00600	
36	1.00000	
37	1.00000	
38	1.0360.	
39	1.00000	
41	1.00600	
42	1.00000	
43	1.00000	
46	1.00000	
47	1.00000	
48	1.30090	
51	1.00000	
52	1.00000	

53	1.0000
56	1.0000
57	1.0000
58	1.0000
61	1.0000
62	1.0000
66	1.0000
67	1.0900
71	1.0000
72	1.0000
76	1.0000
77	1.0000
81	1.0060
82	1.0000
86	1.0000
87	1.0000
91	1.0000
92	1.0000
96	1.0000
97	1.0000
101	1.0000
102	1.0000
166	1.3000
107	1.0000
111	1.0000
112	1.0000
11ć	1.0060
117	1.0000

FREQUENCY 582.+88 RAD/SEC 92.706 HZ

NODE NUMBER	ACOUSTIC PRESSURE
1	58327
2	58333
3	58333
4	58361
ć	-,51327
7	58334
8	58 333
9	54363
11	58327
12	58334
13	58334
16	54743
17	54753
18	54753
19	54795
21	54744
22	54755
23	54757
24	54797
20	54746
27	- 5475ú
28	54743
31 32	44427 4444
33	44472
34	44546
36	44L27
37	4446
38	44472
39	44549
41	44432
42	44434
43	44419
46	35777
47	35799
48	35645
51	35777
52	35799
53	3585+
56	35783
57	35892
58	35844
61	.11556
62	.11538
65	.11556
67	.11541
71	.11550
72	. 11 55 3
76	.56532

77	.56522
81	.56532
82	.56524
80	.56527
87	.56532
91	.88473
92	.88468
96	.88473
97	.88459
101	.88471
102	.88473
106	1.00614
107	1.00012
111	1.00014
112	1.00012
116	1.00014
117	1.00600

NODE NUMBER	ACOUSTIC PRESSURE
1	58327
2 .	58333
3	58333
4 .	58361
6	58327
7	58334
8	58333
9	58363
11	58327
12	58334
13	58334
16	54743
17	54753
18	54753 54795
19 21	54744
22	54755
23	54757
24	54797
26	54746
27	54750
28	54743
31	44427
32	4444
33	4+472
34	44546
36	44427
37	4446
38	44472
39	44549
41	44432
42	44434
43	44419
46	35777
47	35799
48	- 35 845
51	35777
<b>5</b> 2	35799

```
-.35854
-.35763
-.35802
-.35844
                     53
56
57
58
61
62
66
                                                                 .11556
                                                                  .11536
                                                                  .11556
                     67
71
72
76
77
81
                                                                  .11541
                                                                 .11550
.11553
.56532
.56522
.56524
                      82
                     86
87
                                                                  .56527
                                                                  .56532
                      91
                                                                  .88473
                      92
                                                                  .88458
                     96
97
                                                                  .88473
                                                                  .88459
                                                                .88471
.88473
1.00014
1.00012
1.00014
                   101
102
106
107
111
                   112
                   110
                                                                1.00614
                                                                1.00600
                ZERO HARMONIC
                                                  HODE
ALPHPC =
                              2.13
ALPHVC =
ALPHFT =
                             -1.+3
```

0.10

ALPHSD = ALPHA =

and a second free the second property and the second secon

FREQUENCY 1392.654 RADISEC

221.648 HZ

NODE NUMBER	ACOUSTIC PRESSU
1	.47280
2	.47298
3	. 47296
4	. 47 37 8
6	. 47260
7	.47300
8	.47295
9	.47385
11	.47281
12	.47303
13	.47300
16	. 32136
17	.32164
18	.32162
19	.32290
21	.32137
22	. 32168
23	. 32176
24	.32292
26	. 32145
27	. 32153
28	.32128
31	03631
	03582
32 33	03501
	03286
34	03630
36	03578
37	03504
36	03277
39	03616
41	03615
42	0366
43	26458
46	26403
47	26298
48	26458
51	26405
52	-, 26280
53	26445
56	26417
57	26312
58	26312
61	98680
- 62	98113
66	98689
67	98118
71	98103
12	-, 98103 -, 60965
7 ċ	-, 60 965

77	60 961	
81	69966	
82	60965	
86	60 976	
87	61939	
91	. 44 211	
92	.44207	
96	. 44210	
97	. 44208	
101	.44199	
102	.44238	
105	1.08053	
107	1.03057	
111	1.00653	
112	1.0.058	
115	1.00652	
117	1.00000	

NODE NUMBER	ACOUSTIC PRESSURE
1	.47286
2	.47298
3	.47296
4	.47378
6	. 47280
7	.47300
8	.47295
9	.47385
11	.47281
12	.47393
13	.47300
16	. 32136
17	.32164
18	. 32162
19	.32290
21	.32137
22	.32168
23	. 32176
24	.32292
26	. 32145
27	. 32153
28	.32128
31	03631
' 32	03582
33	6 3 50 1
34	03286
36 •	03 £30
37	03578
38	03504
39	33277
41	03616
42	03615
43	03656
46	26458
47 48	26403
	26298
51	26458
52	26405

```
-.26280
-.26445
-.26417
-.26312
-.98112
-.98680
                   53
56
57
58
61
                    62
                                                          -.98113
                    6ć
                    67
                                                          -. 98689
                   71
72
76
77
81
                                                          -. 98110
                                                          -.98103
                                                         -.60965
-.60961
-.60965
                    82
                                                          -.60976
                    86
                   87
91
                                                          -.68 939
                   92
96
97
                                                           .44207
                                                           .44210
                                                           . 47208
                                                           .44199
                  101
                  102
                                                          1.0.653
1.00057
1.00053
                  100
                  107
                  111
                                                          1.00058
                  112
                  116
117
                                                          1.00652
                                                          1.00000
              ZERO HARMONIC
                                            HUDE
                                                          2
                          1.37
-1.58
-4.27
6.16
ALPHPC =
ALPHVC =
ALPHFT =
ALPHA =
                          -3.18
```

a comment of the second property and the second property of the seco

FREQUENCY 2198.131 RAD/SEC

348.252 HZ

SEGMENT 1 R

	ACQUETTO DESENTE
NODE NUMBER	ACOUSTIC PRESSURE
1	86844
2	86660
3	86857
4	86989
6	86845
7	86867
8	86850
9	87009
11	86 845
12	86885
13	86875
16	27503 27545
17	27544
18	27774
21	27506
22	27552
23	2758)
24	27756
25	27529
27	27512
28	27449
31	.69532
32	.69463
33	. 69325
34	.68 976
36	.69530
37	.69452
39	.69335
39	.68952
41	.69508
42	.69519
43	.69572
46	.94781
. 47	.94741
4.8	.94697
51	. 94782
52	.9+751
53	.94694
56	.94776
57	.94777
58	.94696
61	.24426
62	. 24425
66	.24427
67	.24429
71	.24443
72	. 24352
76	98723

The state of the s

77	98727
81	98723
82	98732
86	98719
87	98736
91	08221
92	08244
95	08222
97	08241
101	08238
102	08155
106	1.00694
107	1.00089
111	1.00094
112	1.00095
116	1.00090
117	1.50000

NODE NUMBER	ACOUSTIC PRESSU	? !
1	86 644	
2	86660	
3	86 857	
4	86 98 9	
6	8 o 845	
7	86867	
8	86850	
9	87009	
11	86845	
12	86885	
13	86875	
16	27503	
17	27545	
18	27544	
19	27774	
21	27506	
22	27552	
23	27560	
24	27 756	
20	27529	
27	27512	
28	27449	
31	.69532	
32	.69463	
33	.6 +325	
34	.68976	
36	.69533	
37	.69452	
38	.69335	
39	.68952	
41	.69563	
42	.69519	
43	.69572	
46	.94781	
47	.94741	
48	.94697	
51	.94782	
52	.94751	

```
53
56
57
58
                                      .94694
                                      .94776
.94777
.94696
                                      .24426
   51
   62
                                      .24427
   66
   67
                                      .2-429
                                      .24443
   71
72
   70
77
                                     -. 98723
                                     -.98727
-.98723
    81
                                     -.98732
-.98719
-.98736
    82
    86
87
                                     -.08221
    91
                                     -.08244
-.08222
-.08241
    92
    9ó
    97
  101
                                     -.08238
                                      -.08155
  106
                                      1.03094
  107
                                      1.00089
                                      1.00094
  111
                                      1.06695
  112
                                      1.00600
  116
117
                          HODE
                                      3
ZERO HARMONIC
          -.33
-3.10
G.)[
          -3.14
```

ALPHPC = ALPHVC = ALPHFT = ALPHSO = ALPHA =

A comment of the state of the second second

FREQUENCY 2875.811 RAD/SEC

457.700 HZ

SEGMENT 1 R

and the second of the second o

HODE NUMBER	ACOUSTIC PRESSURE
1	.58778
2	.58756
3	.58756
4	.58743
6	.58778
7	.58752
8	.58747
9	.58757
11	• .58777
12	.58783
13	.58776
16	00690
17	-, 00 <del>(9</del> 5
18	00 693
19	00670
21	00689
22	00 €95
23	00 671
24	03796
26	00671
27	00718
28	00752
31	58732
32	58749
33	58748
34	58772
36	58733
37	58758
38	56755
39	58759
41	58735
42	53742
43	58714
46	41116
47	41162
48	41335
51	-,41116
52	41183
53	41360
56	41135
57	41140
58	41257
61	.99881
62	.99844
66	.99883
67	.99855
71	. 99884
72	.99847
76	53617

77	53€16
	53617
81	
82	53616
85	53801
87	53906
91	46121
92	48146
96	48122
97	48147
161	48136
102	48033
106	1.00104
197	1.00094
111	1.00104
112	1.30102
115	1.00100
117	1.00000

NODE NUMBER	ACOUSTIC FRESSURE
1	.58778
	.58756
2 3	.58756
	.58743
6 7	.58778
7	.58752
ě	.53747
9	, 58757
11	.58777
12	.58783
13	.58776
10	00 690
17	J C <del>6</del> 95
18	00 693
19	00 670
21	00689
22	00 695
23	06671
24	30706
26	00671
27	00718
28	00 752
31	- 58732
32	53749
33	58748
34	58772
36	58733 58758
37	58755
38	58759
39	56735
41	58742
42	58714
43	41116
46	41182
47	41102
48	41116
51	41183
52	41103

```
-.41360
               53
                                               -.41135
-.41140
-.41257
.99881
               56
               57
58
                61
                                                 . 99844
                62
                                                 .99883
                60
                                                 .99655
                67
                                                .99884
                71
72
               70
77
81
82
                                               -.53617
                                               -.53816
                                               -.53817
                                               -. 53816
                                               -.53801
-.53906
                86
87
91
                                                -.48121
                                               -.48146
                92
                                               -. 48 122
                90
                                               -.48147
-.48136
-.48033
                97
               101
               102
                                               1.00164
               106
              10?
                                               1.00694
                                                1.00104
               111
                                                1.00102
              112
                                                1.00100
               116
                                                1.00000
               117
            ZERO HARMONIC
                                     MODE
                    1.15
-.17
-3.+3
(.1)
ALPHVC =
```

-2.+5

ALPHPC =

ALPHSD = ALPHA =

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FREQUENCY 3871.957 RADISEC

516.238 HZ

NODE NUMBER	ACOUSTIC PRESSUR
	-,23375
1 2	23350
3	2335
	23275
•	23376
0 ?	
	23352
3	23346
9	23279
11	23375
12	23363
13	23362
16	-10233
17	.10253
19	.10251
19	.10338
21	.10233
22	,16256
23	.10246
2→	.10364
2ó	.10227
27	•10258
28	.10260
31	.14249
32	.14291
33	.14353
3+	.14540
36	.14251
37	.14297
38	.14355
3.9	.14539
41	.14262
42	.14254
43	.14209
. 46	08866
47	08609
48	08704
51	38866
52	03814
53	0 6 688
56	08853
57	08856
58	08751
61	32376
62	32358
66	32377
67	32362
71	32388
72	32275
76	.67705

77	.67725
81	.67765
82	.67722
85	.67713
87	•67635
91	91628
92	91619
9t	91628
97	91619
101	91633
102	91568
106	1.30667
107	1.00668
111	1.00067
112	1.00661
116	1.00068
117	1.00000

NODE NUMBER	ACOUSTIC PRESSUR
1	23375
2	23350
3	23350
4	23275
6	23376
7	23352
8	23346
9 .	23279
11	23375
12	23363
13	23362
16	.19233
17	.10253
18	.10251
19	.10338
21	. 16233
22	•1•256
23	.10246
24	.16364
26	.10227
27	. 10258
28	•1è 26 c
31	.14249
32	.14291
33	.14353
. 34	.14546
36	.14251
37	.14297
38	.14355
39	.14539
41	. 14262
42	.14254
43	.14209
46	08866
- 47	08809
48	08704
51	38866
52	68814

```
-.08688
   53
56
57
                                        -. 0 3 8 5 6

-. 0 8 7 5 1

-. 3 2 3 7 6

-. 3 2 3 5 8

-. 3 2 3 7 7
   58
   61
   62
   66
67
71
72
76
77
81
                                         -.32362
                                         -.32388
                                         -. 32275
                                          .67705
                                          .67725
                                          .67705
                                          .67722
    82
                                         .67713
.67635
-.91628
-.91619
    86
87
    91
    92
   90
97
                                         -.91619
  101
                                         -.91633
                                         -.91568
                                          1.00067
  106
107
                                          1.60668
                                          1.00067
  111
                                          1.00061
  112
                                          1.00000
  116
117
                                          5
ZERO HARMONIC
                             HODE
```

ALPHPC =

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